

ARISTOTLE'S CRITICISM OF PRESOCRATIC  
PHILOSOPHY

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OF  
PRESOCRATIC PHILOSOPHY

BY

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Τοῦτό τοι ἡμετέρης μνημήϊον, ἐσθλὲ Σαβῖνε,  
ἢ λίθος ἢ μικρὴ τῆς μεγάλης φιλίης·  
Αἰεὶ ζητήσω σέ· σὺ δ' εἰ θέμις ἐν φθιμένοισιν,  
τοῦ Λήθης ἐπ' ἔμοι μή τι πῖης ὕδατος.

Anthologia Graeca VII, 346.

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## FOREWORD

One who undertakes the study of Greek philosophy before the time of Aristotle quickly becomes aware of the influence which is exercised upon all historians of the subject by the remarks of that philosopher. With the exception of the works of Plato the original pre-Aristotelian philosophical writings exist only in meager fragments, and we are constantly forced to resort to the reports of later writers in our attempt to gain some adequate notion of the development of the philosophical and scientific thought which culminated in the Platonic philosophy and of the activity of the early Academy from which grew the system of Aristotle. Even in the case of Plato himself, although we possess probably all of his written works, our direct interpretation of them constantly runs afoul of Aristotle's statements and criticism of Platonic doctrine; and, since Aristotle was a pupil of Plato, the tendency to accept his word against that of the Platonic dialogues has grown to be a persistent dogma.

At the same time it has long been vaguely recognized that Aristotle was capable of setting down something other than the objective truth when he had occasion to write about his predecessors. Although one might expect that an historian who is aware of this possibility would exercise the greatest care in using Aristotle as a witness, it is impossible to discover what criterion has been set up according to which modern interpreters reject one statement of his and accept another; it was concern with this question which prompted the following study. At first it might seem most reasonable, if one intends to test the reliability of Aristotle as an historical source, to compare his reports of Platonic philosophy with the writings of Plato and so to discover where, to what extent, and in what manner he deviates from the original texts; but here one immediately is met by the objection I have just mentioned. It is said that Aristotle must have known Plato better than we can possibly know him from his dialogues; his reports, therefore, must represent the esoteric doctrine which Plato did not deign

to set down in writings intended for the public, or else these reports give the final form of Plato's system whereas the dialogues merely pose problems without answering them and were meant to be only protreptical discourses or programs of study, or finally all save the *Laws* were by their author intended to be historically accurate accounts of the teaching of Socrates and have nothing to do with Platonism except in so far as Platonism developed from the Socratic philosophy. In short, before this method of testing Aristotle could be used, it would first be necessary to establish the accuracy of the dialogues as against him—a vicious circle, however perverse it may seem to reduce the writings of a man to the same level of evidential validity as the statements of his pupil concerning those writings. With the Presocratics, however, the case is different. Aristotle, to be sure, had the books of these men presumably in their complete form while we have only fragments; but those fragments are in many cases just the passages about which he speaks; for this windfall we have to thank his ancient commentators chiefly. He was "nearer" to them than are we, it may be objected; but nearer in time does not mean nearer in spirit, and it can be shown that Aristotle was so consumed with the ideology of Platonism and the new concepts he had himself discovered or developed that it was impossible for him to imagine a time when thinking men did not see the problems of philosophy in the same terms as did he. This, however, requires proof. If we find him making certain, verbal misinterpretations of texts which we possess, his *a priori* superiority as an interpreter vanishes and we have a right to require him to meet us on equal ground in the debate. So much for those cases in which we can control his statements with the original passage; but we have still another weapon. It will be found that he frequently gives conflicting testimony on a single point. Here clearly we are released from the duty of regarding either of the conflicting statements as true. In the third place we may sometimes compare his reports with those of other ancient witnesses; but this method is limited by the fact that most of our doxographical material derives from Theophrastus whose history of philosophy was written under the influence of his master, Aristotle.

Plato, however, offers some important help in applying this method.

There is still another means of attack, one suggested by Aristotle's own contradictory statements. We know that certain concepts and theories were introduced by Aristotle and others by Plato. If a Presocratic theory is presented in a way which involves such a notion, there is clearly something wrong with the statement; but many or most of the contradictions occur in just this manner, the same theory being presented now as equivalent to one Aristotelian doctrine and again as equivalent to another. Merely to say that Aristotle had the habit of "putting things in his own way regardless of historical considerations" (Burnet, *Early Greek Philosophy*<sup>3</sup>, p. 56) does not help us much in restoring them to their original shape, for while the matter may be historically correct and only the form Aristotelian, the form reshapes the matter and the two elements in the unit cannot be separated by instinct. Merely doxographical collections of Aristotle's reports, such as that made by Emminger, however useful they were at the time for indicating the importance of his writings to the student of the Presocratics, are worse than insignificant when the moment comes to evaluate those reports, for they create the false impression that Aristotle was interested in preserving the doctrines of the Presocratics for their own sake. The same danger lurks in the great and indispensable collection of Diels, *Die Fragmente der Vorsokratiker*. The passages have been wrenched from their contexts, and one who uses the collection exclusively comes to feel that Aristotle himself made a collection of "opinions" which Diels has now arranged in conjunction with other doxographical reports and original fragments. Similarly special studies such as those of Natorp on Aristotle and the Eleatics and of Gilbert on Aristotle and the Pythagoreans invariably presume that the various statements of Aristotle concerning a particular philosopher or school of philosophers must form a single consistent whole such as an historian would feel it his duty to present. They then attempt to reconcile the sentences that have been collected from scattered references and proceed to a form of special pleading for or against this reconstruction



which is represented to be "Aristotle's conception" of this or that philosophy. But when the text of Aristotle is consulted one finds that these different reports do not stand alone; they form an integral part of some argument which is meant to establish a positive doctrine of Aristotle's system, and the reports and interpretations vary with the doctrine that is being established. One will also observe that the groupings of philosophers vary from passage to passage, two theories being identified in one place and contrasted in another. Even the few descriptions of the origin and development of philosophical problems and attitudes do not agree with one another. The conclusion is that Aristotle is not, in any of the works we have, attempting to give an historical account of earlier philosophy. He is using these theories as interlocutors in the artificial debates which he sets up to lead "inevitably" to his own solutions, for it is strikingly significant that these writings of his form one long series of dialogues in which one theory is set against another in such a manner that each may bring to light the other's difficulties which are then resolved by a reconciliation:<sup>1</sup> this reconciliation is the Aristotelian system. Such is the meaning and purpose of the "aporetic" method; and Aristotle's belief that all previous theories were stammering attempts to express his own aids him in interpreting those theories out of all resemblance to their original form. He is openly frank about his method of setting down the "inner meaning" of Presocratic doctrines even when such procedure necessitates the "articulation" of implications of which the original author was unaware and results in a system exactly contrary to that which the original text sets forth. Anaxagoras mistook the meaning of his own words, says Aristotle. In such a way he manages to produce interlocutors for his debates who will espouse the opinions necessary for his conclusion. From this it appears that each "debate" must be treated as a whole and the validity of the reports and interpretations judged separately in each case. Moreover, the criticism which Aristotle

<sup>1</sup> After this work was completed, H. D. P. Lee in the *Classical Quarterly*, XXIX (1935), p. 123 noted that Aristotle's review of previous opinions is a form of the dialectical method of reaching the true ἀρχαί of the subject in hand.

gives in the several passages has an importance equal to the reports themselves, since it is from this criticism that we may expect to find the motive for the report and for its special form. Finally, if the criticism is to be understood, the doctrine to which it is meant to lead must be analyzed briefly, for this it is which motivates the critique as the critique motivates the report. Then it will be possible to compare the statements which occur in different places with some hope of discovering the reason for the variations; and once the reason is so established there is a good chance with the aid of our other criteria of stripping off the Aristotelian form or at least of establishing in what direction the statement is likely to have deviated from the original meaning of the theory reported.

It would, no doubt, be best to treat Aristotle's critique of Platonism along with that of the Presocratics, for there is no separation of them in Aristotle's own presentation. The difficulties mentioned above, however, as well as the external exigencies of space and time prevent this; in some cases brief references must be made to the treatment of Plato, but no analysis of that treatment will be undertaken here. After the special results of the investigation, which includes an examination and analysis of all of Aristotle's reports and criticisms of the Presocratics, have been completed, an attempt will be made to draw together the more general tendencies of his interpretation and the sources of the common errors. Such an outline should be the basis of the more difficult study to come, an examination of the nature and validity of Aristotle's testimony concerning Plato and the Platonists. So far as concerns the history of Presocratic philosophy this study can be only the beginning of a critical examination of our sources. It is *prima facie* probable that the doxographical evidence which derives from Theophrastus was at its source contaminated by the attitude and special interpretations of Aristotle. There are certain excerpts from Theophrastus' history, for example, which are clearly mere repetitions of various Aristotelian passages which will be discussed in this study. The next step must be a careful analysis of Theophrastus and the doxographies to determine the extent to which this tendency has perverted our

post-Aristotelian sources. The later contaminations, particularly those arising from Stoic interpretations, would also merit a special study. So much for the relationship of this investigation to the history of Presocratic philosophy, which term, by the way, is used in the conventional sense in which Aristotle already understood "the ancients," namely as including all those thinkers who had not come under the Socratic influence even though chronologically not earlier than Socrates. In some few cases it will be necessary to discuss passages not concerned with these philosophers, particularly those which have been mistaken or might be mistaken for Presocratic references.

If Aristotle's use of earlier theories is such as has been described, the following investigation should be of some moment in the better comprehension of his own philosophical method. While there is not space in which to elaborate such a study, there will be occasion at times to refer to this phase of the problem, for once the reports and critiques have been returned to their proper contexts and their relationship to those contexts analyzed, Aristotle's own conception of the unity of his work both in itself and as the culmination of all previous thought assumes a new significance. In the light of this relationship, too, it may appear that the proper approach to Aristotle's systematic philosophy is that which corresponds with his own notion of the origin of his system, namely by way of his predecessors both in their true historical form and in their metamorphosis as lisping Aristotelians.

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The works of Aristotle are cited by page, column, and line of the Prussian Academy edition (Berlin, 1831), the fragments of Aristotle by the numbers of the Teubner edition (ed. V. Rose, Leipzig, 1886), the Aristotelian commentators by page and line of the Prussian Academy edition (Berlin, 1882-1909); for the Presocratics I have used *Die Fragmente der Vorsokratiker* von H. Diels (4th edition, Berlin, 1922), since only the first two fascicles of the fifth edition by W. Kranz have reached me at this time.

I desire to express my thanks to my colleague and friend, Professor George Boas, who has read my manuscript and has made various helpful suggestions.

## CHAPTER ONE

### THE PRINCIPLES

At the beginning of the treatise on the physical world<sup>1</sup> Aristotle attempts by logical dichotomy to give a list of all the possible physical principles. The basis of the physical world may be considered to be one or many. As one, it may be thought to be immovable—and so Parmenides and Melissus conceived it—or in motion—thus the physical philosophers took it to be, some of them fixing on air, others on water, as the first principle. As many, it may be thought to be a limited number of principles or an unlimited number, limited as any definite number; unlimited either as being generically one but different in shape or figure—so thought Democritus—or as being opposites. By this last possibility the doctrine of Anaxagoras is signified.<sup>2</sup>

Before examining these several possibilities, Aristotle introduces what seems to be a defense of his method of beginning an investigation of physics with an account of the principles of the physical world.<sup>3</sup> Even those who investigate the number of existences (*τὰ ὄντα ζητοῦντες πόσα*) begin with a determination of the primary components of things to see whether they are one

<sup>1</sup> *Physics* 184 B 15 ff.

<sup>2</sup> Cf. Simplicius *ad loc.* The difficulty raised by Alexander is futile. The passage on which he bases his belief that the principles of Democritus are contraries, *Physics* 188 A 22, is one in which Aristotle is trying to reinterpret *all* previous theories so as to bring them into agreement with his own doctrine that generation requires and is due to the contrariety of principles, and there he pretends to prove that all the doctrines given in the passage before us come to agreement on this necessity, though their authors were not clearly aware of it themselves.

As for Anaxagoras, *fragment* 15 (Diels) shows the type of statement on which Aristotle founded this interpretation. Tannery and Burnet (*E. G. P.*<sup>3</sup>, p. 263) follow this interpretation in explaining the original theory.

<sup>3</sup> This was the interpretation of Alexander. Simplicius tries to make the passage mean that Aristotle believed the Eleatic doctrine of the unity of Being referred only to the concept of Being as the principle and cause of individualized existence and was not meant to deny phenomenal multiplicity. This is a favorite thesis of Simplicius; but, whatever Parmenides and Melissus really meant, Aristotle certainly took the Eleatic unity to refer to the physical world. Cf., however, page 66, note 270 *infra*.

or many, and if many whether limited or unlimited; that is, they begin with the principle of Being. To what persons and what sort of investigation is Aristotle here referring? Alexander understood him to mean the physical philosophers; but in that case the passage would be merely a repetition of the preceding analysis, for the existences in the view of those men were just the principles which they had assumed. The direct reference seems to be Plato's *Sophist*,<sup>4</sup> where the Stranger objects that the early philosophers set up their various principles as "existences" and argued that "Being" was one or two or three as though "Being" were a simple and self-evident notion, whereas it is just as difficult to understand as Non-Being and requires further analysis. That introduction leads to the development of the theory of predication. Aristotle here means to say that both physical and ontological science must begin with the establishment of principles which are to serve as components of the particular objects of their investigations. The importance of this concatenation we shall later observe.<sup>5</sup>

The principles we have here to consider are the primary components of individual material existences. They are that into which the material existences may be broken down and which themselves cannot be broken down into other things specifically different.<sup>6</sup> By experiment one can determine what these components are; for example, the dissolution of wood results in fire and earth, but fire cannot be dissolved into flesh or wood.<sup>7</sup> Of those who said these elements are many, Empedocles posited a limited number, fire, earth, and the related bodies, but Anaxagoras held the opposite opinion. He made flesh, bone, and so forth the elementary components; and fire and earth he called mixtures of these seeds, which exist in the mixtures as invisible parts. And all the seeds exist in every mixture. These "seeds" of Anaxagoras Aristotle constantly calls *ὁμοιομερῆ* or "homogeneous bodies," though his language here shows that he did not mean to imply that this was the word Anaxagoras used for

<sup>4</sup> *Sophist* 242 C 4-6: καὶ πᾶς ὅστις πῶποτε ἐπὶ κρίσιν ὤρμησε τοῦ τὰ ὄντα διορίσασθαι πόσα τε καὶ ποῖά ἐστιν.

<sup>5</sup> Page 61 *infra*.

<sup>6</sup> *De Caelo* 302 A 15-18.

<sup>7</sup> *De Caelo* 302 A 19-25.

them.<sup>8</sup> The term *ὁμοιομερῆ* was Aristotle's technical term for the homogeneous materials of which the organs of the animal body are made; and his application of it to the theory of Anaxagoras must imply that the latter really did speak of bone, flesh, etc. as the constituents of those bodies which Empedocles had made the elements.<sup>9</sup> It is because all the *ὁμοιομερῆ* are immanent in the so-called elements that everything is generated (or seems to be generated) from these elements.

Aristotle objects to this theory first on the ground that it mistakes the very nature of elemental component, which according to his definition must be a simple body irresolvable into specifically different parts. The theory of Anaxagoras he claims would allow us to set many bodies which are the result of mixture on the same plane as his "seeds," so long as they are divisible into homogeneous parts. In short, Aristotle objects that the theory does not allow for any elements at all.<sup>10</sup> But perhaps it was just the contention of this theory that there are no simple elements! Such seems to have been the opinion Aristotle had of it, and therefore he has prefixed to this objection a proof of the existence of simple elements which rests upon his significant doctrine of natural places and proper motion. Since<sup>11</sup> every physical body has its proper motion and the proper motion of a composite body is a compound motion, that of a simple body simple motion, it is evident that there are simple bodies, for there are simple motions. This doctrine is used to refute the most widely various theories of previous philosophers; nowhere is it more important to Aristotle than in his criticism of their theories about the material principles.

But Anaxagoras makes another error<sup>12</sup> by supposing the com-

<sup>8</sup> *De Caelo* 302 A 28-302 B 5:—N. B. τὰ γὰρ ὁμοιομερῆ στοιχεῖα (λέγω δ' ὅλον σάρκα καὶ ὀστούν καὶ τῶν τοιούτων ἕκαστον). Also note that Anaxagoras did not himself speak of fire, though Aristotle constantly translated the word he used into the name of his own element. τὸ γὰρ πῦρ καὶ τὸν ἀλθέρα προσαγορεύει ταῦτό.

<sup>9</sup> See page 4, note 14. Shorey (*Class. Phil.*, XVII [1922], p. 350) notes that Plato, *Protagoras* 329 D-E is presumptive evidence against the use of the term *ὁμοιομερῆ* by Anaxagoras. It indicates also the source of Aristotle's example of the difference between "organ" and "homogeneous tissue."

<sup>10</sup> *De Caelo* 302 B 14-20.

<sup>11</sup> *De Caelo* 302 B 5.

<sup>12</sup> *De Caelo* 302 B 20-30.



ponents to be of unlimited number. Even if we understand elements to be such as he describes them, we can achieve the same explanations of physical nature by positing a limited number as Empedocles<sup>18</sup> does. For even with an unlimited number of principles, he cannot construct all bodies of homogeneous elements,<sup>14</sup> and it is best to make the principles as few as possible just as mathematicians do. This refutation in part involves a contradiction of interpretation of the theory, in part it rests upon a rule of economy which Aristotle extends from the sphere of logical thought to the laws of nature.<sup>15</sup> But he lays most stress upon the objection with which he closes the criticism of Anaxagoras, and which is to be taken most seriously because it rests upon one of the foundations of his own system. Since<sup>16</sup> any material body is said to be other than another in consequence of its proper differentiae and these differentiae are limited in number (as they are, for they are sensible qualities which are limited), it is evident that the elements are limited. The argument is certainly vague and the conclusion is not strict; but with it are connected some of Aristotle's dearest doctrines. In the essay on the Senses<sup>17</sup> he attempts to prove that the sensible qualities are limited in number, because the objects of sense exhibit contrariety, and, as contraries are extremes, and the parts enclosed by extremes must be determinate, the objects of each sense are limited in number. That argument is an answer to the theory that bodies are infinitely divisible and so may their sensuous qualities be; and the kinship of the answer there with our present passage is more clearly marked by the conclusion that

<sup>18</sup> *De Caelo* 302 B 23: *κἂν δύο ἢ τρία μόνον ἢ τοιαῦτα, καθάπερ ἐπιχειρεῖ καὶ Ἐμπεδοκλῆς*. Empedocles said there are four. But "two or three" here means merely "a limited number."

<sup>14</sup> "For example they cannot construct a face out of faces." This implies that the "seeds" were minute exemplars of individual things; but Aristotle's term for them, *δμοιομερῆ*, proves that he did not believe that to be the meaning of Anaxagoras; a "face" or "hand" is not *δμοιομερές* in Aristotle's terminology, e. g., *Part. An.* 646 A 20-25, *Topics* 135 A 20-B 6, page 3 *supra*, and especially *De Generatione* 314 A 18-20.

<sup>15</sup> Cf. *Gen. Animal.* 739 B 14-20, especially *ἡ δὲ φύσις οὐδὲν ποιεῖ περίεργον*.

<sup>16</sup> *De Caelo* 302 B 30-303 A 3.

<sup>17</sup> *De Sensu*, chap. VI, especially 445 B 21-28.

there is no imperceptible magnitude.<sup>18</sup> Further, in the essay on Generation<sup>19</sup> he gives an exhaustive list of the tactile qualities, which are the only qualities of body *quâ* body, and from those of the tactile qualities which are irreducible he derives the primary qualities of matter and so the primary bodies. It is noteworthy, however, that in the essay on the Soul<sup>20</sup> he attempts to prove in the opposite direction, from the number of elements which he has determined, that there can be no more than five senses. The true reason for his insistence upon a finite number of elements, a finite number of sensible qualities, and a finite number of senses, which are the senses man commands, is one and the same, the belief in the perfection of intellectual activity and of science.<sup>21</sup>

With the theory of Anaxagoras is related that of Democritus and Leucippus in that they too posit an infinite number of principles. But<sup>22</sup> for them the principles are indivisible magnitudes by the mechanical interconnection of which all things are generated. Though they do not put the case clearly, their real meaning, Aristotle says, is that everything is number and made of number.<sup>23</sup> These primary bodies differ from one another in shape, and, as there is an infinite number of shapes, there is an infinite number of bodies. With the exception of fire, however, to which they attribute the sphere, they have not defined the shape of the elements; but they distinguish air and water and the rest by size. Against this theory Aristotle first brings the objections urged against Anaxagoras,<sup>24</sup> that the same results could be obtained with a limited number of principles and that the

<sup>18</sup> *De Sensu* 446 A 10-20. Magnitudes may be actually imperceptible in isolation, but they are potentially perceptible always; and in combination are actually perceptible also.

<sup>19</sup> *De Generatione* 329 B 7 ff.

<sup>20</sup> *De Anima* 424 B 22 ff.

<sup>21</sup> Cf. the remarks of Themistius and Alexander in Rodier's *Traité de l'Ame*, II, p. 346. See page 51 *infra*.

<sup>22</sup> *De Caelo* 303 A 2-303 B 8.

<sup>23</sup> *Τρόπον γὰρ τινὰ καὶ οὗτοι πάντα τὰ ὄντα ποιοῦσιν ἀριθμοὺς καὶ ἐξ ἀριθμῶν*. The *καὶ* points to the Pythagoreans according to most interpreters. Cf. Burnet, *E. G. P.*<sup>3</sup>, p. 336. See page 13 *infra*.

<sup>24</sup> *De Caelo* 303 A 17-303 B 8.



finite number of material differentiae requires the elements to be limited in number, next refers briefly to the mathematical impossibility of atomic bodies and to the inconsistency of such a supposition with the necessarily continuous character of matter,<sup>25</sup> and then he claims that in two respects the Atomists contradict themselves. They say that water, air, earth arise out of one another by separation. But, since these substances differ from one another in size, there will come a point in the process of the separation of the smaller from the larger at which the larger will all have been separated out and this will be the end of generation. This conclusion is for Aristotle an absurdity; the world process is eternal and this assumption, in conjunction with the doctrine that an infinite body (such as Anaximander posited to provide for an eternity of generation) is an impossibility, makes the clearest necessity of the reciprocal generation of the elements.<sup>26</sup> On the mechanism of the separation itself, however, this account is vague and suspicious, for it differs in no essential respect from the account of the method of Empedocles, and it implies that for these three bodies, at least, the Atomists made no use of two of their three primary characteristics, shape and position, although fire was obviously distinguished by the shape of the atoms of which it consisted. It seems probable, then, that the refutation rests upon a false account of the theory; but this we may be better able to verify when we examine the arguments concerned specifically with generation.<sup>27</sup> The second self-contradiction with which the Atomists are charged is their doctrine that the principles are infinite in number and are bodies differing from one another in figure. All figures, says Aristotle, are constructed of a finite number of primary figures and the number of these principles of shape should be the principles of the Atomists, which would then be limited in number. The source of this criticism is the

<sup>25</sup> This is clearly the character of phenomena referred to as treated in the treatises on time and motion. The continuity of matter, motion, and space is a single doctrine as treated in *Physics*, Book IV, chaps. 10-14, Book VI, chaps. 1 and 2.

<sup>26</sup> Cf. *De Caelo* 305 B 20 where this argument is used against Empedocles, Democritus, and Anaxagoras.

<sup>27</sup> Pages 119-120 *infra*.

*Timaeus* of Plato<sup>28</sup> where the four elements and shape of the universe itself are equated with the five regular solids which are constructions of two kinds of triangle. Characteristically, Aristotle has used a doctrine of Plato to which he does not subscribe—namely, that material body is constructed of discrete and immaterial forms—to refute another theory against which he is arguing. But, worse, the apparent contradiction would be proved only if the Atomists had said that the figures of their atoms were all regular figures; and for this assumption there is not only no evidence, but their statement that the forms of the atoms are innumerable in kind, as well as the express statement of Aristotle himself,<sup>29</sup> shows that every kind of irregular shape was assumed; and in that case the objection does not hold.

We have already transcribed the argument from proper motion by means of which it was proved against Anaxagoras that simple bodies exist since there are simple motions and each body has a proper motion. Starting again from the axiom that a simple body has a simple motion proper to it, Aristotle proves that these simple bodies must be finite in number, for, since there are but two types of simple locomotion (i. e. rectilinear and circular) and a finite number of places (or positions),<sup>30</sup> there must be a finite number of simple motions. It is assumed that there is an exclusive relationship between the character of the simple body and its motion so that the number of elements and of simple motions should coincide, though Aristotle's own doctrine of generation makes it necessary for him to provide two elements the motions of which are strictly only relative to the absolute motions of fire and earth. It is on the same premise that he attacks the Atomistic notion that all the elemental constituents have one and the same qualitative nature<sup>31</sup> and are differentiated only by figure, size, and position. If that were the case, they would all have the same natural motion; but it is clear

<sup>28</sup> *Timaeus* 53 C 4 ff.

<sup>29</sup> *Apud* Simplicius, *de Caelo*, Aristotle, *frag.* 208 (Rose): *ὑπάρχειν δὲ αὐταῖς παντοίας μορφὰς καὶ σχήματα παντοῖα*; *De Generatione* 314 A 21-24.

<sup>30</sup> Six, in fact. Cf. *Physics* 208 B 8 ff. But "up" and "down" in nature are defined by the motion of fire and earth.

<sup>31</sup> *De Caelo* 275 B 29-276 A 4.



from observation that fire naturally and invariably has a direction of motion different from that of earth, and, besides, that an aggregate of fire however great has the same direction as the smallest spark. Consequently the motion of these bodies is immediately related to the qualitative characteristics of the matter and cannot be explained by the quantity of the aggregate. In short there is absolute weight and lightness<sup>32</sup> which is evidence of qualitative difference in the primary constituents of material body. This refutation of the qualitative identity of matter, then, depends upon the same experimental evidence as the refutation of the numerical infinity of the elementary bodies. The passage in which it occurs, however, is directly concerned with the refutation of the infinite spatial extent of the universe;<sup>33</sup> and a later consideration of the passage as a whole will demonstrate how, from the observation that fire rises and earth falls, Aristotle felt constrained to oppose all theories of space, motion, and matter which were not so constructed as to vindicate the primary qualitative nature of this phenomenon.

The belief that the qualitative differences of bodies must be based upon primary and irreducible elemental qualities is the foundation of the argument against all attempts to explain generation by the reorganization of elemental bodies having only quantitative distinctions.<sup>34</sup> The two schools of thought whose physical philosophies rested upon this notion were, according to Aristotle, the Platonists and the Atomists, and the present attack is aimed at them. Such theories, it is contended, have to maintain that there is a limit to the divisibility of matter, a notion contradicted by mathematical science but indispensable to the theory that distinguishes the elements by shape,<sup>35</sup> for the result of dividing a pyramid or sphere<sup>36</sup> is not pyramids and spheres, which means that a section of fire, for example, would not be fire but there would be something prior to the elements. For the moment it is sufficient to notice a peculiarity of Aristotle's appeal to mathematics which, by showing

<sup>32</sup> *De Caelo* 276 A 12-16.

<sup>34</sup> *De Caelo* 305 B 28-307 B 19.

<sup>33</sup> *De Caelo* 276 A 16-17.

<sup>35</sup> *De Caelo* 306 A 26-306 B 2.

<sup>36</sup> The pyramid is the shape of the minimal quantum of fire for Plato; for Democritus fire consists of spherical atoms.

that even the intelligible quanta are divisible, proves material quanta to be so. His final answer to the paradoxes of Zeno, which assume the infinite divisibility of magnitude, is simply the distinction between potential and actual divisibility and the contention that, though magnitude is potentially divisible to infinity, in actuality it is not but its essence and reality is continuity.<sup>37</sup> There is no exposition anywhere in his criticism of the Atomists of the reason why this explanation could not be applied to the quanta they posited; but it is not my purpose here, or anywhere in this study, to show that Aristotle's own doctrines are as vulnerable as those he criticizes. Rather do I make this comparison to emphasize the attitude of his critique, for it is because he never understood the atoms as mere magnitude that he could use against them a thesis which he had elsewhere to modify in order to meet difficulties of another order. It is atoms as the ultimate principles of physical generation that he is criticizing, and particularly as the constitutive principles of his four primal manifestations of matter, earth, air, fire, and water. Consequently, even his next objection, that bodies which are aggregates of minimal quanta with definite shape could not completely fill the space they occupy, depends, as he says himself, on the observation that water and air naturally assume the shape of the inner limits of their containers.<sup>38</sup> This part of the argument seems directed against Plato;<sup>39</sup> at any rate it does not touch the Atomists, for it does not take into account the irregular solids and the interstitial void which make their theory immune to this objection, at least. But the object of the critique is wider than the refutation of the special theory attacked, as is shown by the conclusion that, since the elements must be considered the material substrate of the bodies constructed from them, they must themselves be without shape or figure. And the necessity which motivates Aristotle's discontent with this

<sup>37</sup> *Physics* 263 A 23-263 B 3.

<sup>38</sup> *De Caelo* 306 B 3-22; especially 9-11: *ἔπειτα φαίνεται πάντα μὲν τὰ ἀπλᾶ σώματα σχηματιζόμενα τῷ περιέχοντι τόπῳ μάλιστα δὲ τὸ ὕδωρ καὶ ὁ ἀήρ.*

<sup>39</sup> The reference to the *Timaeus* (lines 18-19) suggests this; and the argument concerning the pyramid and cube (lines 7-9), which implies that the octahedron and icosahedron, Plato's other primary figures, do not fulfil one of their requisite functions, makes it practically certain.



type of material principle as with all others is that of the mutual interchange of the elements, the maintenance of the world of change by the generation of the four primal bodies from one another.<sup>40</sup> This interchange can be accomplished by no theory which does not endow the primary bodies with essential qualities by the mere mutual displacement of which the bodies themselves become one another; but such constructions as those under examination cannot account even for the existence of continuous bodies such as flesh,<sup>41</sup> for continuity cannot result from mere accretion and, even if the elements themselves<sup>42</sup> are the result of such accretion, the bodies generated from these elements certainly are not. The difficulty here touched is a real one which might fairly be thought to have been unsatisfactorily met by all his forerunners. The final answer has not yet been given, and the problem is usually avoided. But the implication that Plato and the Atomists did not *try* to answer it is false, though the latter met it as weakly as all mechanists do; and the notion that the nature of their material principles should bear the brunt of the difficulty is still more unfair. As for the continuity of those principles themselves, they simply asserted that each atom was continuous and indivisible, just as Aristotle simply assumes that his potential matter and, consequently, the four primal bodies are continuous;<sup>43</sup> but as a cause for the con-

<sup>40</sup> Cf. the last sentence in the above passage: διὸ καὶ δύναται μεταβάλλειν εἰς ἄλληλα χωριζομένων τῶν κατὰ πάθη διαφορῶν.

<sup>41</sup> *De Caelo* 306 B 22-29.

<sup>42</sup> στοιχεῖα in the sense of fire, earth, air, water. Although the word is sometimes used to designate the constitutive elements of any theory, whatever they may have been, Aristotle usually means by it the four primary bodies of Empedocles, Plato, and himself, for by this time the term was exclusively reserved to them. These four bodies are for Plato equated with the tetrahedron, cube, octahedron, and icosahedron which, in turn, are constructed of atomic triangles; and, in this sense, the "elements" are for him aggregates. How this applies to the Atomists, though, is not so clear; for, if a single spherical atom is fire, that "element" is not an aggregate. A constant confusion is created for Aristotle by his notion that all systems must have considered earth, air, fire, and water as prior and essentially simpler than other bodies, though there is no reason to suppose that this was a tenet of the Atomists.

<sup>43</sup> Aristotle, in fact, never notices that since potential matter is continuous there is a difficulty in supposing that the four bodies should be discontinuous

tinuity of an individual piece of flesh he must call in the form which is neither material nor materially different from Plato's explanation.<sup>44</sup> Democritus would appeal to the shape of the atoms and to the direction of their motions which, being the effect of their interplay, is not far removed from their essential nature. However that may be, it is not really the problem of continuous body as such which here is at stake, but the nature of generation. Such a conception of the elements removes the possibility of generation, Aristotle says in closing this paragraph, for he feels that the continuity of matter, even as its qualitative distinctions, cannot be mere appearance but must inhere in its very essence; and this objection to matter as an aggregation of discrete quanta leads him immediately to insist that the attempt to derive the qualities and potencies from the figure of the atomic bodies is meaningless.<sup>45</sup> To say that fire is swiftly moving because it consists of bodies the shape of which is least stationary is to overlook the fact that not merely the speed but the direction of motion is specifically different for each of the elements. The sphere is the most mobile of figures in rotary motion, but its shape cannot account for the natural upward rectilinear motion of fire; and, since each body is the most stationary body in its proper place but mobile in the place of another body, if one were to derive motion from figure, it would be necessary to say that fire consists of cubes when in the region of fire, of spheres in the region of earth, water, or air. Likewise, such a characteristic potency as burning cannot be the result of the shape of the atoms, for then all bodies would have the same potencies differing only in degree. Such a conclusion is for Aristotle absurd, because, in reducing the objects of sensation to unity of essence, it implies that the world of the senses consists of distinctions only *apparently* delimited be-

one with another. His own doctrine unwittingly makes spatial discontinuity a result of qualitative change in the continuous substrate while the Atomists made qualitative change and apparent continuity results of the physical arrangement and motion of the discrete atoms.

<sup>44</sup> Aristotle tried to satisfy his own demand for an explanation of the continuity of homogeneous bodies on a different basis from that of the simple elementary bodies by developing a theory of chemical combination (*μῖξις*), cf. page 141 *infra*.

<sup>45</sup> *De Caelo* 306 B 29-307 B 19.



tween which exist connections imperceptible to sense.<sup>46</sup> There are qualities which are really contraries, hot and cold for example. But how can these theorists, who account for hotness by the peculiar figure of the fiery atoms, account for this contrariety since no figure is contrary to another?<sup>47</sup> The objective reality of this contrariety of qualities is at the root of Aristotle's physics and psychology; it is the chief means he has to ensure the possibility of exhaustive knowledge of the real world.<sup>48</sup>

By the experiment of burning wood or flesh Aristotle thought to prove that fire and earth exist potentially in such compounds and may be brought to actuality by a process of decomposition. The fact has been used against Anaxagoras to show that flesh or wood is *not* a component of fire, for example.<sup>49</sup> But it also stands against such theories as were built upon a single material element, for it is obvious that the other bodies do not exist potentially in one simple body. What, then, would be the manner of their generation from it?<sup>50</sup> Since the constitutive elements cannot be infinite in number, there remains only to decide how many they are; and Aristotle must first deal with those philosophers who derived the whole material world from a single principle.<sup>51</sup> Those who make this principle water or air or a body midway between water and air in density and then generate other bodies by the condensation and rarefaction of this principle<sup>52</sup> unwittingly create something prior to their prin-

<sup>46</sup> Cf. page 4 *supra* on the relationship between the limited number of sensible qualities and the limited number of elements.

<sup>47</sup> *De Caelo* 307 B 5-10; cf. *De Sensu* 442 B 17-21.

<sup>48</sup> The argument of 307 A 19-24 I have omitted, for it does not touch the Atomists who assigned the characteristics mentioned only to *material* figures. To be sure, the objection is not valid against Plato either, as Proclus demonstrated (Simplicius, *ad loc.*), but it was obviously aimed at Plato or Xenocrates. In fact, the whole passage from *ἐτι δὲ* (A 13) to *ὡς λέγουσιν* (A 24) seems to be restricted to the Platonists by *πρῶτον μὲν οὖν κατὰ τὴν κίνησιν ἀμφοτέρω διημαρτήκασιν* (A 3-4) and by the employment of Democritus against the view under discussion (A 16-17).

<sup>49</sup> Cf. pages 2 ff. *supra*.

<sup>50</sup> *De Caelo* 302 A 25-28.

<sup>51</sup> *De Caelo* 303 B 9-304 B 22.

<sup>52</sup> Simplicius gives the names of those who held these various doctrines:—Thales and Hippo, water; Anaximander, "an undefined thing rarer than water

ciple itself, for they call generation from the elements combination and the return to the elements dissolution. Consequently the more subtle body must be naturally prior; and, since they all consider fire to be the most subtle, fire ought to be their primary body. The argument is directed against the priority of any intermediate state, but the real objection to the notion of a single element is the same as that which was urged against the atomic hypothesis, that it reduces essential differences to quantitative degree.<sup>53</sup> This method of generation from a single body by condensation and rarefaction amounts to differentiating the essence of physical bodies by the size of their parts (since rarefaction is simply attenuation and that is tenuous which consists of small parts); and the result is that the essence of each body will be nothing more than a relationship, the same thing being fire with respect to one body and air with respect to another. This is the same sorry result to which Atomism comes.<sup>54</sup> The entire criticism rests upon the supposition that the body taken as primary by these theorists is intermediate in density between two extremes of rarefaction and condensation. This presumably Anaximenes did suppose; but there is evidence to the effect that he was the first to use this mechanism,<sup>55</sup> and Aristotle elsewhere describes the method of generation from the first principle used by Anaximander as quite different<sup>56</sup> and, from this point of view, associates his theory with that of Empedocles and Anaxagoras rather than with that of Anaximenes. It is probable, then, that the school which held to the mechanism of rarefaction derived from Anaximenes; but whether or not Aristotle thought his objection to that theory was valid also against

and denser than air and infinite; Anaximenes, an infinite body, but air, and not an undetermined body, like that of Anaximander." There is difficulty in accepting the "intermediate" body as that of Anaximander, because in other places Aristotle speaks of such an "element" intermediate between fire and air and also between water and fire. Cf. Burnet, *E. G. P.*<sup>3</sup>, pp. 55-57, cf. pages 17, note 70; 54, note 215 *infra*.

<sup>53</sup> Cf. page 11 *supra*.

<sup>54</sup> See page 5, note 23 *supra*.

<sup>55</sup> Simplicius, *Physics*, p. 149, 32, says Theophrastus assigned it to Anaximenes alone. Cf. Burnet, *op. cit.*, p. 74, note 1.

<sup>56</sup> *Physics* 187 A 20-23.



Anaximander we cannot be sure, since he does not directly name him in connection with it.

Those who say that the rarest body, fire, is the prime element are not liable to the same criticism; but those who confer upon it a proper figure lay themselves open to the objections urged against the Atomists and Platonists. Here, too, there is difficulty in identifying the persons meant, for, though the form spoken of is the pyramid which was the figure of fire for Plato and the Pythagoreans,<sup>57</sup> neither made fire the sole element. Moreover, in this passage there are two different opinions given, one which attributed to fire as the "sharpest" body the pyramid because it is the "sharpest" figure, and another which more cleverly reasoned that as fire is the primary component of body, being the most subtile, and as the pyramid is the primary element of figure, the pyramid is the figure of fire. Of the Pythagoreans there was one, Hippasus, who did consider fire to be the unique element;<sup>58</sup> and he may have combined with this doctrine the Pythagorean notion of the shape of fire. But the former reference is probably to Plato who does assign the pyramid to fire because it is the most mobile, sharpest, and lightest figure;<sup>59</sup> and, if this identification is correct, it is a gross misrepresentation on the part of Aristotle.

If there were really any philosophers who assigned a definite figure to fire and at the same time made it the sole element, we have no other hint of them. Others, however, make fire the primary body because they consider it the most subtile; and from the composition of this element all others are generated as from the melting down of metal scrapings. This description of generation is unintelligible. The theory referred to here is that of Heraclitus, certainly; but we cannot be sure for that reason whether Aristotle means this simile to represent condensation of the kind Anaximenes assumed. In two passages<sup>60</sup> Aristotle seems to say that all the physical monists used this method of generation; but we have already seen that there is one passage in which the notion is implicitly denied for Anaxi-

<sup>57</sup> Simplicius, *de Caelo*, p. 621, 9.

<sup>59</sup> *Timaeus* 56 AB.

<sup>58</sup> *Metaphysics* 984 A 7.

<sup>60</sup> *Physics* 189 B 8; *Metaphysics* 988 B 34 ff.

mander,<sup>61</sup> even though at times Aristotle talks as though he, too, were included in the general statement. For Heraclitus the evidence is even more uncertain. The words used here are vague<sup>62</sup> and not the usual terms which Aristotle employs for condensation and the simile is so unsuited to signify a change of nature that Alexander took it to be a tacit criticism of the theory, meaning that the process described by these thinkers could cause no material alteration.<sup>63</sup> It seems likely that the indefinite language reflects Aristotle's own conception of the manner in which generation of the bodies other than fire was caused in the system of Heraclitus, and we know that Theophrastus was not certain about the matter.<sup>64</sup>

However Aristotle may have understood this process, he makes no more of it but seeks to show that, alike for him who assigns fire a definite figure and him who does not, the fact that the more subtile body must stand in quantitative relation to the grosser body and so the more extended body must be divisible by the less extended requires that there be an element prior to the element which was assumed to be primary. For the one a section of the pyramid will not be fire, though it is a component of the elemental fire, for the other any quantity which he assumes as the element, fire, can be divided into sections which will not be that quantity he assumed but components of it. This argument attacks the term *μικρομερέστατον*, "most subtile," which the Heracliteans presumably considered the necessary and sufficient characteristic of elemental body. Such a determination Aristotle considers to be essentially as vicious as that of the atom, for it makes qualitative differentiation depend upon quantitative measurement and so reduces it to a scale of degree. If subtilty is material and quantitative, it is liable to infinite rarefaction because the parts of the given body are infinitely divisible, so that any body designated the element because of its state of rarity can be shown—so long as it is body—to have

<sup>61</sup> Cf. page 13 *supra*.

<sup>62</sup> ἐκ τούτου συντιθεμένου φασὶ γίγνεσθαι τὰλλα καθάπερ ἂν εἰ συμφυσωμένου ψήγματος.

<sup>63</sup> Alexander *apud* Simplicius, *de Caelo*, p. 621, 20-25.

<sup>64</sup> Cf. Burnet, *op. cit.*, pp. 146 f., and Diels, *Doxographi Graeci*, p. 164 f.



some density and so to presuppose a more subtile body which by definition is prior to it. There is no end to this process until Heraclitus claims that we have reached the absolutely subtile; and such a statement would make him an Atomist, liable to the objections to which that school is obnoxious.<sup>65</sup> And, if he does not turn Atomist, still his theory is essentially the same as theirs, for, says Aristotle, again showing his real motive for this critique, he makes all body mere relationship, so that the same body is fire with respect to one thing and air and water and earth with respect to others. That Heraclitus himself practically asserted as the final truth this conclusion which Aristotle draws as an absurdity shows only how consistently the latter fails to consider the point of view and final purpose of the theories he criticizes. "This world is an everliving fire kindling in measure and in measure being extinguished" is for him a physical theory to be judged according to his own requirements for a consistent explanation of generation and alteration in the physical world.

The final criticism of all philosophers indiscriminately who posit a single element is that which rests on the doctrine of proper motion. The Atomists whose principles were distinguished only by quantitative differentiae must, according to Aristotle, have all things moving in the same direction since the material of the atoms is essentially one. Naturally, then, if all bodies are one, in the sense that their material constituents are the same, the natural and unimpeded motion of all must be the same. Moreover the larger the body is the more swiftly it moves in the direction of its proper place. But we see different bodies moving naturally in different directions, so that experience, as well as the demonstration previously made, that there are more natural motions of physical objects than one alone, proves that these bodies cannot consist of a single material.

The problems of magnitude, motion, and time confronted Aristotle with the question of infinity; and his investigation of that concept begins with a review of its treatment at the hands of previous thinkers, who, he finds, were all agreed in consider-

<sup>65</sup> Note the analogous method of identifying Empedocles with the Atomists, page 60 *infra*.

ing the infinite as in some sense a constitutive principle of existing things.<sup>66</sup> But the Pythagoreans<sup>67</sup> considered the infinite to be itself substance, a substance present in sensible matter, and the one substance present outside the boundary of the universe. This infinitude they equated with even number which, being limited by odd number, furnishes to the world of existence its characteristic infinitude.<sup>68</sup> An example, given as proof of this, is the variation of the figure constructed with gnomons of an even number of units and the maintenance of the original figure when gnomons of an odd number of units are used in the construction.<sup>69</sup>

After correcting himself by asserting that those who make the elements limited in number (but more than one) do not consider them as infinite in extent, Aristotle says that all the physicists who posited a single material principle<sup>70</sup> made infinite magnitude a qualification of that principle and that those who set up an infinite number of principles in the manner either of Democritus or Anaxagoras were led to the same result,

<sup>66</sup> *Physics* 203 A 1-203 B 15.

<sup>67</sup> Also Plato, according to Aristotle.

<sup>68</sup> The argument of the Pythagoreans for making the infinite a substance present in sensible objects seems here to be supplied by Aristotle on his own authority: 203 A 6-7, οὐ γὰρ χωριστὸν εἶναι λέγουσι τὸν ἀριθμόν. If this is so, the equation of even number = infinitude may also be a deduction of Aristotle. (Professor Heidel holds that the two pairs, even-odd, limit-unlimited, were originally not identified and that for early Pythagoreanism, at any rate, the ἀπειρον was not equivalent to κενόν. See *Archiv für Geschichte der Philosophie*, XIV, pp. 384 ff., especially 391 and 394-7.) With the phrase, καὶ παρέχειν τοῖς οὐσι τὴν ἀπειρίαν cf. the suspected statement of Damascius (Aristotle, *frag.* 207, Rose), 'Ἀριστοτέλης δὲ ἐν τοῖς Ἀρχυτέλοις ἱστορεῖ καὶ Πυθαγόραν ἄλλο τὴν ὕλην καλεῖν ὡς ῥευστὴν καὶ ἀεὶ ἄλλο γιγνόμενον. The ascription to Pythagoras is enough to impugn the authenticity of this quotation.

<sup>69</sup> See Carteron's edition of the *Physics* in the Budé series, vol. I, page 164; the suggestion of A. Rey, *La Jeunesse de la Science Grecque*, p. 291; and A. E. Taylor in *Class. Review*, XL (1926), pp. 149 f.

<sup>70</sup> The examples given here are water, air, τὸ μεταξὺ τούτων. Simplicius (458, 23 ff.) takes the last to be the principle of Anaximander. Cf. page 12, note 52. It is clear that this passage means to include *all* the physical monists; and that, though τὸ μεταξὺ τούτων can hardly include fire, Aristotle does not mean to exempt the principle of Heraclitus from this category. See pages 49, note 199; 54, note 215 *infra*.

for the continuity resulting from the contact of their primary bodies is an infinite magnitude. The description of the system of Anaxagoras which is here introduced<sup>71</sup> furnishes the key to Aristotle's intentions in this critique. He desires to reduce the doctrines of Anaxagoras and Democritus to essential identity with those of the physical monists, and he does this by proving that the primary matter of each is qualitatively homogeneous. This is done very simply for the Atomists, since they admit that the differentiations of their infinite number of principles is only quantitative, so that Aristotle can say that for them the principle of all things is the homogeneous body common to all, passing over in silence here the contention that change and becoming depend upon the quantitative characteristics as the principle. Qualitatively the primary body of Democritus is homogeneous and infinite, then, in the same sense as that of Anaximenes. But Anaxagoras seemed to make the qualitative differences original and immutable. By stressing the cosmogonical moment in the account of Anaxagoras, however, Aristotle seeks to show that the original material principle of this doctrine is a continuously infinite homogeneity also. For, in order to maintain the permanence of qualities, each individual object is considered to be a mixture of the same kind as the whole, that is all qualities are present in every object. And since there must be a definite commencement of separation, not merely for each object from which is engendered another in the present state of nature, but also for the first act of genesis, there was a time before the unique impulse of *νοῦς* when the whole of nature consisted of an homogeneous mixture of all qualities. And so the doctrine of Anaxagoras, too, in its account of the material principle coincides with that of Anaximenes.<sup>72</sup>

<sup>71</sup> 203 A 23-33.

<sup>72</sup> Aristotle here is aided in this reduction of the doctrine of Anaxagoras by treating the "mixture" in his own sense of "chemical combination," although Anaxagoras meant by it only a mechanical arrangement of particles which does not present a true homogeneity. (This mistake in interpretation gives rise to the criticism of *De Generatione* 327 B 19-31.) In fact the homogeneity of any material Anaxagoras claimed to be only apparent and due to the weakness of sense (cf. Ritter and Preller<sup>9</sup>, § 161).

Whether infinity be posited as a substance or as a specific characteristic of the principle of material existence, that which is infinite must be considered the ungenerated, immortal principle of things. And being indestructible, as Anaximander and most of the physical philosophers said, it is rightly called divine.<sup>73</sup>

Aristotle emphasizes in this fashion the necessity of considering the infinite to be the principle of all things in order to make the more vivid the implications of his refutation of the possibility of an infinite whether as substance or essential attribute, for once this refutation is established the doctrines of the principle propounded by all the Ionians as well as those of the Pythagoreans, Atomists, and Anaxagoras will have been automatically disproved.

The reasons which have led men to believe in the existence of infinitude he gives as five: <sup>74</sup> the nature of time; the divisibility of magnitudes; the necessity of an inexhaustible supply of material to insure the eternal continuance of the world of change; the nature of physical limit which requires the existence of a limiting body that must in turn be either infinite or limited by a third body; and, most important, the inexhaustibility of thought which can always supply the conception of something beyond any given limit. This last, he claims, is the reason why men have supposed infinite body and innumerable universes to exist. For, once space is conceived to be infinite, there is no reason for supposing that a void exists rather in one place than in another. And, even if the existence of void be granted, if

<sup>73</sup> 203 B 4-15. Note that here he cites the phrase *περιέχειν ἅπαντα καὶ πάντα κυβερνᾶν*, which is taken to be a direct quotation from Anaximander (Hippolytus, *ref. haer.*, I, 6 [*Doxographi Graeci*, p. 559, 17-18]), as rightly applicable to the infinite if it exists; and that later (*Physics* 208 A 2-4), when he has defined infinity as "in essence, privation" and has said that it exists as material cause—in his own sense in which such a cause is "pure potentiality"—, he remarks that, since all others, too, used it as material cause, it is absurd to make it *τὸ περιέχον* . . . ἀλλὰ μὴ τὸ περιεχόμενον. This is an example of Aristotle's "philosophical punning." Since Anaximander used infinity as matter and matter is "limited by form," he should have called infinity not "the encompassing" but "the encompassed."

<sup>74</sup> *Physics* 203 B 15-30.



one takes the infinity of space for possible, one must do the same for matter. And since the potential, in eternal objects, does not differ from the actual, infinite matter will necessarily exist. These five reasons are of varying historical value; and the manner in which Aristotle places them all on the same footing illuminates his method of criticism. He does not say that they were all consciously adduced to support the belief in an infinite but groups together what may be arguments really offered and unconscious, psychological needs which forced men to such a belief. The fifth reason seems to be such an unconscious necessity; at any rate, the developed form in which it is here given is based upon the peculiarly Aristotelian notion of potency and actuality so that it is clear that no one before his time could have contrived such an argument.<sup>75</sup> The second, also, the infinite divisibility of magnitudes, seems never to have been urged as an argument for the existence of a body of infinite extent. It seems to have caused the mathematicians to say that any given magnitude was in some sense infinite because every magnitude is infinitely divisible, and this, probably, led to much confusion about the concept of infinity of the kind which Aristotle explains by his "potentially infinite by division and addition,"<sup>76</sup> but the object of this confusion was minimal quantities and had nothing to do with infinitely extended

<sup>75</sup> Simplicius (467, 26) quotes Eudemus as putting an argument of this kind into the mouth of Archytas; but that argument has been recast to correspond step for step with this "fifth reason" of Aristotle and includes the fully developed Aristotelian doctrine of space and pure actuality (lines 33-35). If the Peripatetic form of the quotation is stripped off, the original argument of Archytas seems most likely to fall under the fourth type given here, that based on the nature of physical limit. Aristotle's own designation of it  $\delta \tau \eta \nu \kappa \omicron \iota \nu \eta \nu \pi \omicron \iota \epsilon \iota \alpha \nu \omicron \pi \omicron \lambda \alpha \nu \pi \alpha \sigma \iota \nu$  implies that no specific argument mentioned it.

<sup>76</sup> Simplicius (466, 24-7) by his statement of the conclusion of the mathematicians ( $\epsilon \lambda \delta \epsilon \xi \sigma \tau \iota \nu \eta \epsilon \iota \varsigma \alpha \pi \epsilon \iota \rho \omicron \nu \tau \omicron \mu \eta \nu$ ,  $\xi \sigma \tau \iota \tau \omicron \alpha \pi \epsilon \iota \rho \omicron \nu \epsilon \nu \tau \omega \mu \epsilon \gamma \epsilon \theta \epsilon \iota$ .  $\omicron \upsilon \gamma \alpha \rho \alpha \nu \epsilon \lambda \mu \eta \alpha \pi \epsilon \iota \rho \omicron \nu \eta \nu \epsilon \tau \epsilon \mu \nu \epsilon \tau \omicron \epsilon \pi' \alpha \pi \epsilon \iota \rho \omicron \nu$ .) implies rather that they sought to establish an infinite as a minimal quantity, the real existence of an infinite which would serve as the object of the process of unlimited division—a confusion arising from the materialization of the concept of limit. The argument of Anaxagoras, however, in support of infinitely small and infinitely large magnitudes may have suggested both the second and fifth reasons. Cf. Simplicius, *Phys.*, 164, 17 ff.; 166, 15 ff.

bodies. The third reason, the necessity of an inexhaustible supply of material, is said to have been given by Anaximander, though here the later evidence clearly depends, either directly or by way of Theophrastus, on two passages of Aristotle—one of which is the passage before us—in neither of which it is definitely assigned to him.<sup>77</sup> Simplicius<sup>78</sup> says that it was the argument that persuaded "some of the physicists" to make the principle infinite. The fourth, the nature of physical limit, seems really to have been urged by Archytas,<sup>79</sup> and one argument for the infinite extent of Being quoted by Aristotle and obviously taken from Melissus is of the same nature.<sup>80</sup> The first reason given, that men are led on from temporal infinity to believe in the existence of material infinity, coincides with Aristotle's objection that Melissus derived the spatial infinity of Being from the fact that it has no beginning in time,<sup>81</sup> and this argument is probably in Aristotle's mind here. That the specific objection is based upon a misinterpretation of the words of Melissus is another matter.<sup>82</sup>

The analysis of this passage illustrates Aristotle's method of reference to previous philosophers; he has drawn up a general list of the *possible* reasons for believing in an infinite material, in order to have a systematic plan of refuting the belief; his list is drawn partly from historical arguments, partly from his own deduction of the probable psychological reasons which prompted previous doctrines; and even the historical arguments are so generalized that their identification is almost im-

<sup>77</sup> Cf. *Doxographi Graeci*, pp. 277 f. The other Aristotelian passage is *Physics* 208 A 8. Cf. also Baeumker, *Problem der Materie*, pp. 13 f.; Burnet, *E. G. P.*<sup>3</sup>, p. 57 (but in note 2 the phrase "a passage in which Anaximander has just been named" must be disregarded, for, if everything after the name were to be attributed to him, we should have to believe that he gave all five of the reasons here listed); Zeller-Nestle, *Philosophie der Griechen*<sup>6</sup>, I, p. 272.

<sup>78</sup> Simplicius, *Phys.*, 466, 30.

<sup>79</sup> See page 20, note 75 *supra*.

<sup>80</sup> *De Generatione* 325 A 15:  $\tau \omicron \gamma \alpha \rho \pi \epsilon \rho \alpha \varsigma \pi \epsilon \rho \alpha \lambda \nu \epsilon \iota \nu \alpha \nu \pi \rho \omicron \varsigma \tau \omicron \kappa \epsilon \nu \omicron \nu$ . Melissus' argument has, of course, another element, since he denies the existence of the  $\kappa \epsilon \nu \omicron \nu$  and so does not have to go on to establish an infinite regress. Cf. Zeller-Nestle, *op. cit.*, p. 772, note 2.

<sup>81</sup> *Physics* 186 A 13; *Soph. Elench.* 167 B 12-20; *Soph. Elench.* 168 B 35 ff.

<sup>82</sup> See Burnet, *op. cit.*, p. 325.



possible. These are then set together on the same plane without any concern for historical accuracy. Aristotle is interested in his predecessors, not as an historian but as a philosopher; and his method is aggravated by his firm belief that each previous thinker was groping blindly for the truth under the constraint of necessity,<sup>83</sup> that their mistakes and successes are to be measured by the approximation to his own system which is the final realization of what all previous doctrines were only potentially.

The generalized arguments for the existence of infinitude Aristotle attempts to dispatch as follows.<sup>84</sup> He tacitly admits that the world of change must be eternal, but this does not require an actually existing infinite material, for it is possible that one part of the finite whole should by its destruction provide generation for another part, so that a limited amount of matter would be in a constant process of change. Nor need that which is finite be limited by the contact of another body. Contact and limitation are different categories; and, while the former is a relationship, the latter is not. That is to say, the limit of the delimited is a part of itself not of some other thing, so that it is wrong to suppose that the finite is limited by physical contact. As for arguing that an inexhaustibility of thought is reason for positing an infinitude in nature, this is to overlook the fact that the increase or diminution fancied is such only in the fancy and not in the objects, for the representation of an object in thought stands to the object only in accidental relationship. Here Aristotle seeks to dismiss the argument as not truly physical; the Eleatics had insisted that one can conceive only that which really exists, for the conceptual and the physical worlds had not yet been divided. And Aristotle feels that this argument for the existence of infinitude rests upon the same confusion. But it is doubtful that he has stated the reason itself correctly, for it is not so much that one believes there must be something outside the celestial sphere because one can always imagine something more outside it as it is that one is forced *not* to accept a limit to the universe because no reason for stopping the continuous extension of thought presents itself. This leads us back to his answer to the nature of limit, for to

<sup>83</sup> Cf. *Metaphysics* 984 B 8-11.

<sup>84</sup> *Physics* 208 A 5-22.

Aristotle there seemed to be a cogent reason for stopping that extension. When he says that limit is different from contact he does not imply merely that the limit is of the limited in the sense that the limiting surface is part of the limited object but that every object is limited by its essential form and so every object must be limited and limited by itself. The world is a cosmos and has a form which limits it from within.<sup>85</sup> The argu-

<sup>85</sup> The infinite is essentially formless and so contrary to what is whole and finished. (See *Physics* 207 A 1.) For this reason (*Physics* 207 A 15 ff.) Melissus was wrong in calling the whole infinite against the statement of Parmenides that it was limited and in equilibrium from the center. Those who make the universe infinite do so because they think infinity has some similarity to the whole or perfection, as their phrases about it, τὸ πάντα περιέχειν (Anaximander, cf. page 19, note 73) and τὸ πᾶν ἐν ἑαυτῷ ἔχειν (Anaxagoras, cf. *Physics* 205 B 1-4 and pages 31-32 *infra*), show. But it is only *potentially* whole as the material of actual magnitude. As such it has no form and in itself is unknowable. The whole implies limitation by form and the form "bounds" the matter, so that quā unlimited the infinite is rather that which is enclosed than that which encloses (cf. *Physics* 208 A 2-4 and page 19, note 73). Consequently, as unformed matter it should be considered a part, not a perfected whole.

Aristotle understands the infinite Being of Melissus to be corporeal as he does that of Parmenides here. (In this he is followed by Baeumker, *op. cit.*, pages 57-59, and Burnet, *op. cit.*, page 327.) In *Physics* 185 A 32-185 B 5, however, he finds it necessary to *prove* that the Being of Melissus is quantitative, which he does by showing that, since it is called infinite, it cannot be substance, quality, or affection except *per accidens* and, since it is called *one*, it must be restricted to a single category. *Metaphysics* 986 B 18-21 is usually cited as proof that the Being of Melissus was corporeal; but there, too, Aristotle says that Melissus *seems* to have treated material unity and that this is the reason why he made the One infinite. In contrast, he says that Parmenides seems to have treated the One as conceptual and so made it finite; but that clause of the same sentence is not cited as proof either that Parmenides meant conceptual Being or that Aristotle thought he did. The doxographical portion of the sentence here is Aristotle's own conclusion which he thinks necessary in order to render explicable the different doctrines of the two concerning the extension of Unity. *De Caelo* 298 B 21-24 reports that neither one believed in the existence of anything except sensible substance, but there the Eleatic doctrine is explained by saying that those men saw that the objects of thought must be unchangeable and eternal and applied these characteristics to the sensible world.

Clearly, then, though Aristotle believed that both meant something corporeal by their one Being, he had no distinct notion of what sort of thing it was and did not find any passage in the writings of either which could settle his uncertainty; and we are not justified in using these remarks of his as clear evidence that the *Being* of the Eleatics was the material world.



ments from the infinity of time and infinite divisibility of magnitude are not here considered, except that, in passing, he says that thought itself is infinite as are time and motion while no given part of it subsists. They are passed over here because Aristotle considers both time and magnitude to be *potentially*, though never actually, infinite by division and accretion.<sup>86</sup>

This passage, however, aims to prove no more than that the requirements which seem to urge men to posit infinitude may be otherwise satisfied. The particular refutations of the infinities posited by previous schools are still to be considered, and first the argument against the substantial infinity of the Pythagoreans. But to understand the Pythagoreanism which Aristotle is criticizing it is important to remember that he considers its doctrine of infinity to be essentially the same as Plato's.<sup>87</sup> They must have considered infinity to be a substance, he argues, since they make it, quâ infinite, the element of existing objects; and, as such, it cannot exist *per accidens*.<sup>88</sup> Such infinitude cannot exist, he maintains, because as substance it cannot be infinite and as actually existing it must be an attribute and not substance.<sup>89</sup> As substance it is indivisible, for the divisible is either magnitude or quantity; but if indivisible, it is not infinite in the sense its champions assert, for that which is not quantitative is infinite only by general negation, as not belonging to the genus of which the finite is a species.<sup>90</sup> This argument derives from the doctrine of categories; what is in itself substance can-

<sup>86</sup> But see page 34 and *Physics* 206 B 16-20.

<sup>87</sup> *Physics* 203 A 4 ff. The mistaken notion that Plato posited two infinities (203 A 15-16) is sufficient to put Aristotle's whole account of this matter under suspicion.

<sup>88</sup> *Physics* 204 A 14-17. The presence of this sentence in the midst of the argument against substantial infinity troubled Simplicius, who saw that it could not be directed against *an infinite body* but did not quite see what it is doing here. (Simplicius, 472 and especially lines 26-31.) But it clearly shows that Aristotle felt that he had no conclusive evidence for a Pythagorean doctrine of *substantial* infinity and so was constrained to *prove* that the infinity they posited must be substance.

<sup>89</sup> *Physics* 204 A 8-34 and *Metaphysics* 1066 B 1-21. The two passages present the same argument almost word for word with slight transpositions.

<sup>90</sup> See *Metaphysics* 1022 B 22; 1055 B 4 and Ross's note *ad loc.*, vol. II, p. 292 of his edition.

not be quantitative, since quantity is an attribute. On the other hand, if infinitude exists in actuality, it must be either divisible, in which case it would be divisible into an infinite number of infinities, since as substance each part of it must be essentially infinitude, or indivisible, in which case it is not quantitatively infinite; but both conclusions are impossible, so that if it exists in actuality it must be an attribute and not substance. If, then, it is an attribute, not it but the substance of which it is an attribute is the material principle, for example *air* or *even number*.

This mention of air as the principle is a defense of Anaximenes<sup>91</sup> and Diogenes<sup>92</sup> against Anaximander, as the *even number* refers to the Pythagoreans. Elsewhere Aristotle implies that *the infinite* of Anaximander was an infinite *body*, though he does not definitely say so.<sup>93</sup> But such a contradiction may well spring from uncertainty on Aristotle's part as to what Anaximander really meant. So, too, the substantial infinity, which is here attributed to the Pythagoreans and is previously<sup>94</sup> said to form the exterior of the heaven, is in a later passage<sup>95</sup> called "infinite breath" and is equated with the "void." One element of the argument above<sup>96</sup> Aristotle inserted because he felt it necessary to prove that the Pythagoreans did really posit a substantial infinity and so to justify his assignment of that belief in like manner to them and to the Platonists. A further refutation which he has included just after this argument<sup>97</sup>

<sup>91</sup> See *Doxographi Graeci*, p. 476, 16 ff.

<sup>92</sup> Simplicius, 475, 7.

<sup>93</sup> *Metaphysics* 1069 B 22, he calls it a *μῖγμα*; *Physics* 187 A 20-23, he calls it *τὸ ἐν* from which the contraries are separated out and likens it to the principles of Empedocles and Anaxagoras of whom he then says: *ἐκ τοῦ μίγματος γὰρ καὶ οὗτοι ἐκκρίνουσι τὰλλα*; *Physics* 203 B 14, he says Anaximander called the infinite "deathless" and the phrase *περιέχειν ἅπαντα* four lines above is supposed to be quoted from him (cf. p. 19, note 73 *supra*), though he assigns it to "as many as have no other principles than the infinite." Burnet's references (*E. G. P.*<sup>2</sup>, p. 55, note 3) all (except that to Simplicius) are to passages in which Anaximander is not expressly named; we have already seen (page 17, note 70) that one example of the phrase Burnet refers to the principle of Anaximander cannot refer exclusively to it at any rate. Cf. pages 49, note 199; 54, note 215.

<sup>94</sup> 203 A 6-7.

<sup>95</sup> 213 B 22 ff.; Aristotle, *frag.* 201.

<sup>96</sup> See page 24, note 88.

<sup>97</sup> In *Metaphysics* 1066 B 1-21 it comes just *before* that argument.



seems meant to intensify this connection of Pythagorean and Platonic doctrine. Since infinity is essentially an attribute of number and magnitude, if these two cannot exist in themselves, infinity is even less capable of substantial existence. The denial of substantial existence to number Aristotle uses against Platonists and Pythagoreans alike, though in this matter, too, it will be seen that he is undecided as to how the latter really conceived number.

By this critique Aristotle has sought to reduce the notion of infinity as a material principle to the sense of infinity as an attribute, that is to infinitely extended body. The question of intelligible infinity he renounces,<sup>98</sup> his reason being that the infinite, in whatever sense there may be such a thing, exists as matter and so his task is to show that all who have used it, using it as material principle, have misconceived it.<sup>99</sup>

Aristotle thinks it worth while to prefix to his serious refutation of infinitely extended body an argument which he himself designates as merely verbal, namely that from the definition of body as "limited by surface" and of number as "numerable" it follows that both are traversable and so finite.<sup>100</sup> On material magnitude and number this has some bearing, and so on the doctrine, which he at times attributes to the Pythagoreans, of number as corporeal; but the theory of intelligible number and magnitude held by the Platonists, and sometimes attributed to the Pythagoreans in the sense of incorporeal numbers, is untouched by it, though Aristotle implies that the refutation applies to both notions. The inclusion of such verbal arguments along with what he considered scientific reasons may have had only the practical purpose of giving his students weapons for debate similar to those which men of other schools habitually used.

<sup>98</sup> *Physics* 204 A 34-B 4.

<sup>99</sup> *Physics* 207 B 34-208 A 4.

<sup>100</sup> *Physics* 204 B 4-10. The refutation of corporeal infinity here considered occupies *Physics* 204 B 5-206 A 8. *Metaphysics* 1066 B 22-1067 A 33 reproduces the argument almost verbally with one omission. The correspondence is *Metaphysics* 1066 B 22-1067 A 23 = *Physics* 204 B 5-205 A 32; 1067 A 23-33 = 205 B 24-206 A 8. *Metaphysics* 1067 A 33-37 adds an explanation of the different meanings of "infinite" as applied to magnitude, motion, and time.

The serious refutation is divided into two parts and depends upon the doctrines of the constant equilibrium of the elements in the continuous course of their interaction and change and of natural motion and proper position as specific characteristics of material existence. The hypothetical infinite body must be either composite or simple. But it cannot be composite if the elements of the composition are limited in number,<sup>101</sup> for they must be opposites with equivalent potencies and no one of them can be infinite lest the unlimited destroy the limited as it would necessarily do, since, even if the less extensive element had greater intensity of potency, so long as the relation of potencies is a finite numerical proportion, the infinite extent of the weaker would still cause it to surpass in absolute strength the more intense.<sup>102</sup> This same necessity for constant equilibrium of forces is used elsewhere to refute the theory that the translunar bodies consist of fire.<sup>103</sup> On the other hand, not each of the several constituent elements could be infinite, since infinite body has unlimited extension in all directions and they would limit one another.<sup>104</sup> One would think that this argument would suffice

<sup>101</sup> This is the general conclusion of the criticism of the ancients which we have already considered. The doctrine is stated *Physics*, chap. VI, 189 B 27-29.

<sup>102</sup> The examples chosen by Aristotle here are fire for the limited element and air for the unlimited. If Burnet (*op. cit.*, p. 109) correctly conjectures that the early Pythagoreans identified the limit with "fire" and the boundless with "darkness" or "breath" (and we have seen that Aristotle does cite the latter identification; see page 25, note 95 *supra*), this example may be meant as a reference to the Pythagoreans and a specific criticism of their theory.

<sup>103</sup> *Meteorology* 340 A 1 ff. (page 127 *infra*).

<sup>104</sup> This possibility is considered and refuted again in *De Caelo* 274 B 18-22, in the course of a résumé of this argument in the *Physics* (*De Caelo* 274 A 30-B 32.). If the infinite whole should be said to consist of a number of heterogeneous parts, each of which is infinite, each part of the whole would itself occupy infinite space and there would either be no room for the other parts or two bodies would occupy the same place. Simplicius (*De Caelo*, 229, 31 ff.) considers this to be levelled against Anaxagoras while Saint-Hilaire thinks it is meant to refute the Atomists. A comparison of *Physics* 203 A 19-23, where the principles of Anaxagoras and Democritus are shown finally to be the same in that both posit an infinitude which is a continuity by contact, shows that Aristotle had both in mind here, where the general trend of the passage is towards dissolving the apparent differences between those who set up a composite infinitude and those who make it continuous and homogeneous (see pages 17-18).



to prove at once the impossibility of an infinite composed of some finite and one or more infinite elements. That Aristotle chose rather the refutation above shows how consistently the orientation of his critique of the material principles is towards their character as causes of generation and change. But though this infinite body could not be composite, it can no more be one and simple, either as one of the elements or as a body apart from them. Such a principle, he says, some have supposed necessary as the source of the elements in order that the rest might not be destroyed by the one that is infinite. For, since the elements possess contrary qualities, if one were infinite the others would straightway be destroyed by it. Such an infinite body apart from and presumably prior to the so-called elements is supposed to have been set up by Anaximander.<sup>105</sup> But the reason here given for the hypothesis of such a distinct body presupposes the Aristotelian theory of interaction of contraries as the explanation of the genesis of the elements, and this is enough to show that the explanation is not historically correct.<sup>106</sup> No such body can exist, he claims (its infinite extent apart, for the moment), simply because it must be sensible, being body, and yet we have no perceptible sign of it. This refutation itself turns on his definition of body, of which the essential characteristic is tactility, coupled with the doctrine that no imperceptible magnitude exists.<sup>107</sup> In conformity with this he makes his own "primal matter" incorporeal, the first bodies being the four elements, earth etc. But no one of the elements can be infinite, nay, more, it is impossible for the whole world, even if finite, to be one element or a result of one, "as Hera-

<sup>105</sup> See page 21, note 77 *supra*.

<sup>106</sup> As the reason given for the existence of a body distinct from the elements (when these elements did not, in fact, exist in the theory) is false, so the reason given for its having been considered infinite (a reason first definitely assigned to Anaximander by the doxographers; cf. preceding note) may be equally false. Certainly both explanations are given only to be replaced by an Aristotelian doctrine of "primal" matter which fulfills both requirements by *potential* existence prior to the elements and by its potency of becoming each of the elements in turn, being all at any one time in a set proportion.

<sup>107</sup> See pages 4-5 *supra* and *De Generatione* 329 B 7 ff.

clitus says that at some time fire becomes everything,"<sup>108</sup> for all change is from contrary to contrary. This is not a direct refutation of the possibility of an infinite body but a general argument against material monism on the ground that it does not

<sup>108</sup> ὥσπερ Ἡράκλειτος φησιν ἅπαντα γίνεσθαι ποτε πῦρ. The problem is two-fold: 1) Does Aristotle say that according to Heraclitus everything becomes fire, at once, sometime or other? 2) Is this what Heraclitus really meant? The answer to the second question may be postponed, with the remark that Burnet (*op. cit.*, pp. 158-159) is right in saying that a periodic conflagration is inconsistent with the central notion of Heraclitus' system and that the interpretation of Plato (*Sophist* 242 D-E) excludes such a conflagration. In answer to the first question Burnet (*op. cit.*, p. 159) argues that the passage does not imply a general conflagration of the world, Zeller-Nestle (*op. cit.*, pp. 867 ff.) insists that it does. Neither, however, notices that the argument is directed against the possibility of a *single* element and that the same refutation is said to hold both against every theory which makes one of the elements (i.e. fire, earth, air, water), even though finite, the principle of all the world *and* against the theory which considers one body distinct from these four as the element. This refutation is put with enigmatic succinctness as follows: "for all things change from opposite to opposite." The common feature of all these doctrines thus refuted is their material monism which Aristotle says makes genesis impossible, for, all change being between contraries, it is necessary that there be at least two primary bodies. The refutation of this same class of theories on the same ground, but with greater fulness and without the puzzling quotation from Heraclitus, occurs in *De Generatione* 332 A 6-27 and confirms this interpretation. Consequently ἀδύνατον τὸ πᾶν . . . ἢ εἶναι ἢ γίνεσθαι ἐν τι αὐτῶν does not refer to some periodic state of the world but to the material substrate at any given time, and the reference to Heraclitus has the same meaning. For, if Aristotle meant to refer to an Heraclitean doctrine of the reduction of the universe to fire and said that his refutation of this held for the other theories too, he would have to mean that each of the other Ionians taught that the world would one day be dissolved into air or water or the infinite. Moreover, the grammatical subject of the first of the three troublesome clauses, τοῦ ἀπειρον εἶναι τι αὐτῶν is clearly τι αὐτῶν, i.e. "apart from the fact that one of them (the elements) is infinite." Consequently the subject of the next clause is not τὸ πᾶν but ἐν τι αὐτῶν and so means *not* "it is impossible for the universe to be or become any one of them" *but* "for any one of them to be or become the universe," that is, just what Aristotle is trying to prove against all these theorists, that no one element can be the universe either in its original state as fire or air, or in some process of alteration as air or fire compressed into liquid or solid states. Then the construction of the third clause is the same, *not* "as Heraclitus says that all things at some time become fire" (as even Burnet interprets it) *but* "that fire at some time becomes everything." This is in accord with the general teaching of Heraclitus and makes Aristotle's refutation consistent, for, though Burnet is right in



save the phenomenon of change. As such it is logically prior to the premise from which was drawn the argument against a composite infinite, the equilibrium of the elements in interaction.

Clearly this argument rests ultimately upon the assumption that the qualities of matter are underived and irreducible, which is also the basis of the theory of natural places, for Aristotle holds that none of the elementary bodies is fully actualized unless it is in its proper position in the universe; and the natural motion of each is a primary characteristic of it. This is the common root of the arguments which precede and those against an infinite sensible body which follow.

If it is homogeneous, since the proper place of any part is the same as that of the whole, the proper place of each part is infinite; but each part cannot occupy infinite space nor is there any reason for it to move in one direction rather than another. If, then, all parts are at rest there can be no cause for motion; if all parts are in motion there can be no cause for rest.

If, again, it is heterogeneous, the proper places will be so, too, and there will be no continuity of matter but by contact. (The implications of this objection and the manner in which it is connected with the problem of genesis have been observed in the criticism of atomic elements.<sup>109</sup>) Besides, the parts will be either specifically limited or unlimited. The former they cannot be, for some would then be finite and some infinite which would disturb the equilibrium and cause the complete destruction of some of the elements, as was previously shown.<sup>110</sup> Here Aristotle interjects the illuminating explanation that this reasoning prevented the physical philosophers, who set up an infinite element, from making it fire or earth. The natural places of those

saying the passage does not imply a general conflagration, he is wrong in thinking it refers to the "upward and downward path." Aristotle is not arguing that fire cannot become water and earth; it does even in his own system. He simply means that there can be no change at all if only one primary body is posited. See *De Generatione* 332 A 6-20 (page 58 *infra*), 332 B 8-9 (pages 122-123 *infra*).

<sup>109</sup> See pages 10-12 *supra*.

<sup>110</sup> See page 27 *supra*. There numerical limitation was stressed; here it is specific limitation. But since not all the species could be infinite in number, it comes to the same thing.

elements were obviously defined, whereas water or air,<sup>111</sup> being intermediate in position seemed not to have a definite contrary. Such was Aristotle's feeling for the history of philosophy that he could impute to Thales and his followers an argument which presupposes the peculiarly Aristotelian doctrines of equilibrium of opposites and natural places; and such was either his contempt for them or his lack of insight into the implications of his own theories that it seems not to have occurred to him that, had any man thought of that argument, he could not have set up an infinite sensible body at all.

But as the parts of this heterogeneous infinite cannot be specifically limited, so they cannot be unlimited<sup>112</sup> either, for that would imply an infinite number of natural places and an infinite number of elements. That the number of positions in place is limited has been proved;<sup>113</sup> and, since place and body must correspond, the whole must be finite, for, if space is more extensive than body, there must be a void<sup>114</sup> (in which case there will not be an infinite body); and, if body is more extensive than space, there will be body the natural place of which is nowhere.

The argument against the possibility of an homogeneous infinitude assumed that it would be absurd to represent it as everywhere at rest. But this is just what Anaxagoras did, explaining all subsequent motion by the original impulse given to the infinite by the *νοῦς*. Aristotle is, therefore, constrained to introduce a particular refutation of this exposition which he does by insisting once more that rest and motion can be explained only as specific characteristics of matter and that, since not every body

<sup>111</sup> Here again he refers to *ὕδωρ ἢ ἀέρα ἢ τὸ μέσον αὐτῶν*, and the last is sometimes taken to refer to the *ἄπειρον* of Anaximander. But the requirement was only that the element be intermediate between fire and earth, and *αὐτῶν* may as easily refer to them. At any rate, the designation is quite general and is meant to include, I think, every material principle which was infinite.

<sup>112</sup> The addition of *καὶ ἀπλᾶ* merely emphasizes the homogeneity of each part with itself, which has all along been assumed. Were any part not homogeneous it would at once have to be considered as an agglomeration of specifically different parts.

<sup>113</sup> See page 7 *supra*.

<sup>114</sup> The existence of void is disproved in *Physics*, IV, chaps. 8, 9 (cf. pages 151 ff. *infra*).



is at rest of itself in every place, the potentiality of such rest must manifest itself in all other places as natural motion. Anaxagoras<sup>115</sup> gave as the reason for the immobility of the infinite mixture the fact that it rested in itself surrounded by nothing. This, says Aristotle, amounts to saying that the actual position of any given body is its natural position, which is false, for a body may be immobile by constraint. That is, the fact of immobility is no explanation of the cause of that state. For example, imagine the earth expanded to infinity! It would be immobile, but not because it had no place into which to move; rather, because it would still be resting at the center which is its natural position. So one might say of it, as is said of the infinite, that it supports itself; but the cause of that "supporting itself" is something else. It is, in fact, for Aristotle, the essential characteristic of all earth, the possession of absolute weight. The syllogism he offers is a *petitio principii*, for the major, *it has weight*, is by definition equivalent to the conclusion, *it rests at the center*. However, the importance of the argument is just that motion to a definite place must be a prime characteristic of body; and so fundamental is this assumption for Aristotle that he feels even Anaxagoras must have held it in some form and so thinks it consequent to urge again that, if the whole infinite is at rest because to be in itself is to be in its natural place, since the natural place of the whole and of every part is specifically one, all the parts must be immobile.

In two fundamental senses the argument does not touch Anaxagoras. Aristotle assumes that the infinite body was homogeneous as a chemical compound whereas it was merely a fine mechanical mixture,<sup>116</sup> and he does not show why the original motion of the material may not have been imparted from outside, though this is the explanation of Anaxagoras. But this he assumes to be impossible because of the priority of motion, as state, to rest, as privation,<sup>117</sup> and because he opposes as con-

<sup>115</sup> *Physics* 205 B 1-24. This special refutation is omitted in the refutation of the infinite sensible body given in the *Metaphysics*. See page 26, note 100 *supra*.

<sup>116</sup> See page 18, note 72 *supra*.

<sup>117</sup> See *Physics* 251 A 26-27. Cf. *Topics* 148 A 3-9, whence it follows that of what rest is predicated the natural state must be motion. In *Metaphysics* 1072 A

traries natural and constrained motion.<sup>118</sup> If, then, Anaxagoras introduced a motion of constraint, he should also have designated a natural motion; and, if no natural motion, there can be no motion of constraint. This is the reason why he thinks it a sufficient refutation of Anaxagoras' infinite material to have shown that it must be naturally immobile.<sup>119</sup>

To return to the general theory of an infinite sensible body,<sup>120</sup> the requirement that such a body have direction of motion means that there must be absolute directions which are possible only in a closed universe, in a part of which an infinite body can find no room. The element of infinity makes impossible directions, without which natural motion cannot exist. They, in turn, are necessary if the infinite body is to be sensible. As for the varieties of motion, they cannot be explained, since the infinite is indivisible.

The same argument is elsewhere used against the atoms as material principles, as the doctrine of natural motion is used against all material monists.<sup>121</sup> The qualitative identity of the atoms, it was argued, would result in a single direction of motion.<sup>122</sup> Such a condition would necessitate at least one directive reference, which cannot exist in infinite extension.<sup>123</sup> But without absolute direction there can be neither natural nor constrained motion; and, since there are obviously both,<sup>124</sup> the natural motions of the primary bodies must be different; and there can be no actual infinity. The indivisibility of infinity whether spatial or material, in connection with the observed

4-5 Aristotle tries to show that Anaxagoras himself considered *ἐνέργεια* to be prior to *δύναμις* (cf. pages 170-73 *infra*).

<sup>118</sup> E. g. *De Generatione* 333 B 26-30; *De Caelo* 276 A 12-15.

<sup>119</sup> Cf. Alexander *apud* Simplicius, *De Caelo*, 590, 3-11 and *Physics* 230 B 10-21.

<sup>120</sup> *Physics* 205 B 24-31.

<sup>121</sup> See page 16.

<sup>122</sup> See pages 7-8.

<sup>123</sup> *De Caelo* 276 A 6-17. Aristotle considers the material principle of Atomism, also, as an homogeneous body infinite in extent, though not continuous. Cf. pages 17-18.

<sup>124</sup> This is an appeal to experience; ultimately the doctrine rests upon the observation that earth, unhindered, falls and fire rises.



fact of a plurality of natural motions, is the weapon of attack in both the above refutations.

The existence of natural motion, once it is admitted, requires a frame of reference; on this assumption Aristotle is justified in his further demonstration<sup>125</sup> that an infinite body could not exist, since as body it must exist in space and the specific differentiae of space are the directions which are absolute.<sup>126</sup> But these cannot be determined in an infinitude whether spatial or material, so that there can be no infinite body; and, in general, as all body must exist in space, and this cannot be infinite, all body is estopped from infinity on two counts. As definite quantification of an infinite body is impossible so is definite position, for both imply spatial limits. But since the infinite has no position it cannot be in space and so cannot exist in actuality. This reasoning shows Aristotle to have felt that the dogma of a finite universe was founded on observed physical fact; and both his confidence in his own system and his lack of sympathy for all previous philosophy are largely due to his belief that only he has given proper attention to the implications of the falling stone and rising flame.

The belief in a finite universe has a curious influence on his own theory of infinity. Infinity by division does exist potentially;<sup>127</sup> but in magnitudes, though infinity by addition does exist potentially, it does so only within a finite magnitude as an infinitely converging series. That is, infinity by addition, in the sense that any given magnitude may be surpassed, does not exist even potentially. And the reason he himself gives is that it is impossible for an infinite body to exist actually.<sup>128</sup> The doctrine of natural motion encroaches even upon mathematics.<sup>129</sup>

<sup>125</sup> *Physics* 205 B 31-206 A 8.

<sup>126</sup> In *De Caelo* 308 A 14-33 he tries to prove that the directions are absolute from the observation of natural motion up and down. In *De Caelo* II, chap. 2, he discusses the interrelationship of the six directions and tries to show that they all are specific characteristics of the cosmos. Cf. especially 285 A 27-B 5.

<sup>127</sup> *Physics* 206 A 25-B 27.

<sup>128</sup> *Physics* 206 B 20-27. The designation of such infinite sensibles by the words ὥσπερ φασιν οἱ φυσιολόγοι τὸ ἔξω σῶμα τοῦ κόσμου οὐ ἡ οὐσία ἢ ἀήρ ἢ ἄλλο τι τοιοῦτον ἄπειρον εἶναι fits Anaximenes and Diogenes, but οἱ φυσιολόγοι would seem to imply more than them. In *De Anima* 405 A 22 Diogenes "and certain

The application of this doctrine, being of prime importance in astronomy, is considered at the very beginning of the essay on the heavens;<sup>130</sup> and, in confirmation of the analysis of the doctrine given above, the groundwork for proving the finitude of the cosmos is laid in a preliminary examination of the nature of simple motion.<sup>131</sup> In brief, the universe is proved to be finite by reference to the uncontroverted observation that the boundary, that is the circle of fixed stars, revolves in a finite time (the natural motion of their constitutive material is circular, and the circle and circular motion are both finite as limited) and by the argument that the simple bodies of which the cosmos is composed must themselves be finite, since they have definite natural places. One new argument against the possibility of infinite body is added,<sup>132</sup> which itself depends upon the assumption that weight is an absolute quality of matter defined by direction of motion. A body of infinite size would have infinite weight, which means that it would move faster than any conceivable finite body. But this is impossible, for the times required by two bodies to traverse a given distance are inversely proportionate to their respective weights but there is no relation to be established between weights or times one of which is infinite while the other is finite.

The denial of the possibility of substantial infinity rested on the argument that the infinite as quantitative must be an attri-

others " are said to have made the soul air. The doxographers credit this theory to Anaximander, Anaximenes, Anaxagoras, and Archelaus (*Doxographi Graeci*, p. 387). For our passage Anaxagoras and his pupil Archelaus are out of the question. But Anaximander's ἄπειρον would be suitably designated by ἄλλο τι τοιοῦτον, if Aristotle considered it to be an infinite body, though not one of the four elements. (See pages 25-26 and note 93 on page 25.) The name φυσιολόγοι seems to exclude the Pythagoreans, but in some places Aristotle does call their infinite principle "breath" (see pages 25, note 95; 27, note 102; 24, note 88); and, if they are included, it is important to remark that φυσιολόγοι may be used in a wider sense than hitherto accepted.

<sup>129</sup> Aristotle was aware of this and tried to reassure the mathematicians that they do not need the kind of infinity of which his argument deprives them. (*Physics* 207 B 27-34.)

<sup>130</sup> *De Caelo* I, chaps. 5-6-7.

<sup>131</sup> *De Caelo* II, chaps. 2-4.

<sup>132</sup> *De Caelo* 273 A 22-274 A 18.



bute, in which case not it but the substance of which it is predicated is the material principle.<sup>133</sup> The problem of substance is fundamental in Aristotle's account of genesis<sup>134</sup> and consequently in his criticism of the principles of matter posited by his predecessors. He divides previous doctrines into two classes by this criterion, those in which Being or Unity was treated as the substance of existing things and those in which these were considered attributes of a substrate. To the first class belong the theories of the Pythagoreans and Plato, to the second those which, positing one or more constitutive material elements, do not make them classes of the composite things.<sup>135</sup> That Pythagoreans may be classed with Plato as considering the One to be substantial is intelligible; but it would be startling to find Aristotle saying that they also held the classes or genera to be the elements, for that would mean that the Pythagoreans held the theory of Ideas in the sense in which Aristotle interprets that theory. But, when he says "some of those, who call Unity and Being or the Great and Small the elements of things, appear to treat them as classes," he seems to be distinguishing the Platonists from the Pythagoreans.<sup>136</sup> Moreover, it is by the fact that

<sup>133</sup> See page 25.

<sup>134</sup> See *Physics* 190 A 31 ff.

<sup>135</sup> *Metaphysics* 996 A 4-9: Here Empedocles is said to have made the One *φιλία* as another made it fire and still others water or air. In *Metaphysics* 1001 A 12-15 he is said to have told what Unity is. *δόξειε γὰρ ἂν λέγειν τοῦτο τὴν φιλίαν εἶναι. αἰτία γοῦν ἐστὶν αὕτη τοῦ ἐν εἶναι πᾶσιν*. That is, Aristotle takes the state of the world in the *Sphere* to be a state of unity in *φιλία*, though he knows that Empedocles said *φιλία* was the cause of the unity of the *Sphere*. The designation of the *Sphere* as *τὸ ὑποκείμενον* means only that it is the subject of the attribute, Unity; for, though there is a tendency to equate it with his own "prime matter" (cf. *Metaphysics* 1069 B 20 ff.), Aristotle clearly contrasts the substantial existences of Empedocles with those of the Platonists as *πῦρ καὶ ὕδωρ καὶ τὰ μετὰ τούτων στοιχεῖα* in the one case and *γένη τῶν ὄντων* in the other. (Cf. *Metaphysics* 998 A 28-32.) By considering only the state of the *Sphere* he gets a moment in the cosmography of Empedocles comparable to the material monism of Anaximenes and Anaximander. Cf. *Metaphysics* 1053 B 14-16.

<sup>136</sup> *Metaphysics* 998 B 9-11. Ross *ad loc.* seems to refer *τινες* to both Pythagoreans and Plato; *Metaphysics* 1014 B 2-15 also refers to Plato and the Platonists without mention of the Pythagoreans. The derivation of the notion and term, *στοιχεῖον*, with the reference to definition, fits the former and not the latter.

the Pythagoreans do not separate numbers from things but make the perceptible objects consist of numbers that he explicitly differentiates them from the Platonists;<sup>137</sup> and the doctrine that the classes, as universals, are substance he assigns to "the modern philosophers" saying that the older thinkers considered the particulars to be substance.<sup>138</sup> The analysis of Aristotle's refutation of Pythagorean doctrine is complicated by his method of referring never to the particular members of the school<sup>139</sup> but indiscriminately to "the Pythagoreans," "the Italians," or "the so-called Pythagoreans," for, while we know that there must have been variations of doctrine in the history of pre-Aristotelian Pythagoreanism, evidence for them earlier than the text of Aristotle is practically non-existent.<sup>140</sup> Aristotle clearly feels that he can refute with the same argument the basic doctrines of all the Pythagoreans, Plato, and the Platonists, because they depend upon regarding the unit as a substance. This is no evidence at all that the Pythagoreans either stated this or so thought of the matter; but it furnishes a means of separating the original doctrines from the portions of Aristotle's report which are his own reconstructions. Certain definite likenesses and differences of Plato's doctrine and Pythagoreanism are explicitly given to start with.<sup>141</sup> Both make *One* substantial and numbers the causes of the substantiality of individual objects,

<sup>137</sup> E. g. *Metaphysics* 1080 B 14 ff.

<sup>138</sup> *Metaphysics* 1069 A 24-36. Ross, too, identifies *οἱ . . . νῦν* as Platonists. Pythagoreans could certainly not be included; if they were, they could not be any Pythagoreans we know. But they can hardly be understood among *οἱ πάλαι* either, for the particulars referred to them are *οἶον πῦρ καὶ γῆν, ἀλλ' οὐ τὸ κοινὸν, σῶμα*.

<sup>139</sup> Alcmaeon is named in *Metaphysics* 986 A 27, but Aristotle confesses not to know whether his theory of opposites influenced the Pythagoreans or was derived from them. Xouthus, who we know was a Pythagorean, is mentioned in *Physics* 216 B 22-26 in connection with an argument to prove the necessity of the *κενόν*. "Paron the Pythagorean" is the subject of an anecdote in *Physics* 222 B 18 ff. The one important definite reference is that to Eurytus in *Metaphysics* 1092 B 8-13, where his method of proving that number is the "cause" of individual objects is given.

<sup>140</sup> The question of the authenticity and bearing of the "Philolaus fragments" must be postponed with the remark that Aristotle's silence certainly implies that he had not seen the book of Philolaus. See page 386 *infra*.

<sup>141</sup> *Metaphysics* 987 B 22-988 A 1.

but Plato substitutes for the infinite of the Pythagoreans a dyad which he calls "the great-and-small," and he says that numbers exist apart from sensible objects while they say that the individual objects *are* numbers. Aristotle gives the presumptive reason for the introduction of the dyad to be the belief that from it the numbers (except the primary ones) <sup>142</sup> can easily be generated as from a plastic material, while the separation of number and the introduction of the Ideas was due to Plato's logical study. The Pythagoreans, he remarks, did not use the dialectical method. The relation of the Pythagorean numbers to physical objects is here expressed in two ways, number is the cause of the substantiality of objects, the objects themselves are number; and a dozen lines earlier <sup>143</sup> the Pythagoreans are reported to have said that things exist by imitation of number, a doctrine which is synonymous with the Platonic "participation." The other implication of the passage is that the infinite of the Pythagoreans was not suitable as a generative source of number. It has already been shown that Aristotle is not unwavering in his belief that the Pythagoreans posited a substantial infinity <sup>144</sup> and that the equation of infinity with even number may be merely a deduction of his own. <sup>145</sup> It now appears that the Platonic term "dyad," used to designate spatial indeterminateness, may have been the point of departure for this identification, especially since Aristotle has insisted that a refutation of the substantiality of number at once destroys the possibility of substantial infinity, because the infinite is only an attribute of number. <sup>146</sup>

The Pythagoreans are expressly distinguished from all others who make the One the element and principle of things as alone asserting that numbers are not abstract but have magnitude. <sup>147</sup> They make sensible substance out of these numbers, Aristotle concludes, since they construct the universe of numbers. But

<sup>142</sup> For possible meanings of *ἐξω τῶν πρώτων* see Ross's commentary, vol. I, pages 173 ff. I do not propose to analyse or criticize in the present work Aristotle's account of Platonism.

<sup>143</sup> *Metaphysics* 987 B 11-12.

<sup>144</sup> See page 24, note 88, and page 25.

<sup>145</sup> See page 17, note 68.

<sup>146</sup> See pages 25-26.

<sup>147</sup> *Metaphysics* 1080 B 30-33.

evidently he found no Pythagorean explanation of the construction of the first unit of magnitude. That they did generate the unit and from it the rest of the number series Aristotle seems to say in the course of proving that numbers as eternal existences cannot be generated. <sup>148</sup> "There is no doubt that they generate eternal things, for they say that when the One had been constructed the nearest part of the infinite was straightway drawn in and limited by the limit." But, after giving this account, he at once says that it is cosmogonical and has nothing to do with immovable numbers. Consequently, the One here mentioned need not be considered the numerical unit; it is rather the universe itself, outside of which is the infinite breath. <sup>149</sup> His suggestions that they may have constructed this Unity of "planes, surface, seed, or what they are at a loss to say" does not imply that any of these possibilities was suggested by Pythagoreans, but simply that Aristotle is confusing—and half-consciously confusing—the cosmogony with the number-theory. <sup>150</sup> The theory which asserts that numbers have magnitude seems to be concerned only with explaining the existence of individual things, as Aristotle himself admits when he explains that the Pythagoreans asserted that objects are number simply because they saw the characteristics of number in the octave, the heavens, and many perceptible bodies. <sup>151</sup> His refutation, too, implies that the numbers of this theory were aggregates of units rather than constructions generated by a primal unit. The bodies, he says, <sup>152</sup> cannot consist of abstract numbers, since there are no atomic magnitudes <sup>153</sup> or, if there are, abstract units

<sup>148</sup> *Metaphysics* 1091 A 13-22.

<sup>149</sup> See pages 17 and 25. Cf. Aristotle's *fragment* 201, where in the same context the "One" is predicate of *τὸν οὐρανόν*.

<sup>150</sup> The argument against generation of numbers from the Unit on the analogy of reproduction by seed (*Metaphysics* 1092 A 32-33) which Cornford (*Classical Quarterly*, XVII (1923), p. 10, note 1) takes as a reference to Pythagorean theory is addressed to the Platonists, and Speusippus in particular (cf. especially lines 25-26).

<sup>151</sup> *Metaphysics* 1090 A 20-25, cf. also 989 B 33-990 A 5.

<sup>152</sup> *Metaphysics* 1083 B 8-19.

<sup>153</sup> The proof of this occurs in *De Generatione* 315 B 24-317 A 31. Notice the importance in that proof of the continuity of matter and the reality of absolute genesis.



have no magnitude and so no magnitude can be constructed of them.<sup>154</sup> Yet the propositions which they apply to bodies are propositions of abstract numbers. And again he insists that to make corporeal bodies out of numbers is to construct from elements that have no weight or lightness compositions which have both.<sup>155</sup> Obviously this does not meet the thesis, for the Pythagorean units were corporeal; but, though Aristotle knows this, he cannot put himself into the position of men who did not yet know the difference between denominative and abstract numbers. The element of his argument, here only mentioned, that there can be no atomic magnitudes, is the only one that is valid against the view he is refuting. He could not have given clearer warning to be wary of his treatment of more primitive thinkers than by arguing that, since the mathematical propositions they used deal with abstract numbers, the units of which they constructed the world must have been—and must have been for them—mathematicals.<sup>156</sup>

It is generally supposed that Aristotle bears witness to another Pythagorean theory according to which the limits of physical body and geometrical figure are substances and elements of individual objects. In his statement of the problem of substance<sup>157</sup> he says that the earlier philosophers considered body to be substance because it is of body that the qualities are

<sup>154</sup> In *De Caelo* 298 B 33-300 A 14 Aristotle attacks those who construct bodies of planes and "atomic lines" (i. e. Plato and Xenocrates), his basic arguments being that physical bodies display qualities which such elements can not possess and that such theories make mathematical points the only real substance. He then adds (300 A 14-19) that the same refutation holds against those who construct the universe, that is natural existence, of numbers ὡς περ τῶν Πυθαγορείων τινές. Natural bodies have weight and lightness, but the combination of mathematical numbers cannot produce body or weight. Since he has been concerned throughout the passage with the mathematical lines and points of the Platonists, he carries his argument over unchanged and presumes that the Pythagorean numbers also were μονάδες.

<sup>155</sup> *Metaphysics* 1090 A 30-35. Cf. *De Caelo* 300 A 14-19.

<sup>156</sup> It is this confusion which makes him incapable of seeing that the argument of Zeno at which he sneers (*Metaphysics* 1001 B 6-16) is the decisive answer to the theory that lines and bodies are constructed of units. Cf. page 43, note 165 *infra*.

<sup>157</sup> *Metaphysics* 1001 B 26-1002 B 11.

predicated and body which abides during alteration of quality. The later ones called numbers substance because the plane is prior to body, the line to planes, and the unit or point to lines. These are the limits of body and seem to be able to exist apart from it. This view destroys substance altogether, he argues, because, if points, lines, and surfaces are more substantial than body and yet we can find no sort of body of which they are substances (for they cannot be substances of perceptible body), they themselves are not substances at all. But they are merely divisions of body; and since every figure is present in a solid as much as any other, if a given statue be not determinately present, neither is any surface, line, point, or unit. Besides, surfaces are generated and destroyed by union and separation of bodies; but generation of substance requires that the substance be generated from something; yet there is nothing from which surface, lines, or units can be generated. This may refer to both Platonists and Pythagoreans,<sup>158</sup> since the "later philosophers" are said to have treated numbers as substance; but the treatment of planes, lines, and points as incorporeal does not fit the Pythagoreans nor does the statement that these "substances" can exist apart from body. Aristotle has most definitely testified that the Pythagoreans considered the unit as corporeal and not separable;<sup>159</sup> and when

<sup>158</sup> So Ross, *Commentary on Metaphysics*, vol. I, p. 248.

<sup>159</sup> See page 37, note 137; page 38, note 147. In *De Sensu* 445 B 3-20 Aristotle raises the question of the infinite divisibility of sensation and sensible qualities. A preliminary examination produces the conclusion that both must be infinitely divisible to obviate the possibility of small bodies having no sensible qualities, a possibility which would lead to the absurdity of composing sensible body of imperceptible parts. Body must be composed of sensibles since it cannot consist of mathematical. This last statement cannot refer to the Pythagoreans (as Mr. G. R. T. Ross says it does); it is rather a reference to the Platonists. Aristotle goes on to say that the problem could be solved by positing atomic magnitudes, but that atomic magnitudes are impossible as has been proved in the *Physics*. This refers to the Atomists. In *Metaphysics* 1028 B 15-18 it is said that "some" held the limits of body—planes, lines, points, units—to be substances more substantial than solid body. This Alexander (462, 23 ff.) refers to the Platonists, Ross to the Pythagoreans. I think it refers to both; but the next sentence distinguishes the Pythagorean view from that of the Platonists and does not refer to the Presocratics (as Ross thinks it does). ἐτι παρὰ τὰ αἰσθητὰ οἱ μὲν



he considers the bearing of the relation of form to matter on the distinction between body and corporeal limits,<sup>160</sup> he speaks of some, who reduce all things to number and say the formula of line is "two," who still insist that lines and continuous space are the material constituents of figure just as flesh and bones are of a man. These men are then distinguished from the Platonists and so appear to be Pythagoreans; but, if so, Aristotle believes that the substantiality they assign to lines is corporeal, while the number *two* which they call the formula of the line is a corporeal number, for he asserts that they recognized no other and considers this one of the absurdities of their theory.<sup>161</sup> Apparently, then, Aristotle represents the Pythagoreans as constructing bodies of planes and lines which are corporeal since they in turn are constructed of corporeal units, and he distinguishes the Platonistic and Platonic doctrines from this by the belief of the two former in some kind of incorporeal substantiality of unit, point, line, and plane. But, since it is clear to him that the numerical unit must be incorporeal, he feels that the Pythagorean theory can be refuted with the same arguments which are valid against the Platonists.<sup>162</sup>

Similarly, Plato and the Pythagoreans are said to have re-

οὐκ οἶονται εἶναι οὐδὲν τοιοῦτον, οἱ δὲ πλείω καὶ μᾶλλον ὄντα αἰδία κτλ. must, I feel the μέν . . . δέ shows, refer to subsidiary divisions among those who made the πέρατα substances. Another passage shows that Aristotle considered the limits of body, of which the Pythagoreans spoke, to be sensible. In *De Sensu* 439 A 30-B 1 where he is discussing the nature of color he says that they called the surface of body color (χρoιά), and he objects to this on the ground that color is not the πέρας itself but is ἐν τῷ πέρατι.

<sup>160</sup> *Metaphysics* 1036 B 7-13.

<sup>161</sup> *Metaphysics* 990 A 18-22. Consequently the argument of *Metaphysics* 1090 B 5-13 must be directed against the Platonists (and not the Pythagoreans, as Ross believes), for to show that limits which have substantiality are not separable from the bodies of which they are limits is no refutation of a theory which regarded them as inseparable. Aristotle, however, may well have thought that the first part of his argument applied to Pythagoreans as well as Platonists, for there he argues that, if the extremities, quâ limit, are substantial, the limit of motion (and so motion) would be substance also. But this is a confusion of the presumable Pythagorean reasoning which seems rather to have been that the limits, quâ number (and corporeal number) and not quâ limit, are substances.

<sup>162</sup> See pages 39-40.

garded the One as the prime substance from which numbers and objects are derived; and in this treatment the Units of both theories are tacitly considered to be essentially identical. That this is due to Aristotle's own reinterpretation appears from his statement that all the physical philosophers and even those who set up a plurality of elements posit unity and being as the origin of generation and existence.<sup>163</sup> The corporeal units of the Pythagoreans seem more closely related to the atomic bodies of Democritus; but the argument that, if unity is not substance, number can have no separable existence, since number is units and the unit is essentially one,<sup>164</sup> evidently seemed to Aristotle sufficient grounds for identifying the Pythagorean unit with that of the Platonists. The number of the Pythagoreans was a self-contradictory concept; Aristotle, stressing its mathematical aspect, probably because he could not comprehend how the Pythagoreans could have failed to distinguish between conceptual number and numbered objects, treats it as mathematical only. His reasoning would prove that the Pythagorean units, being corporeal, are not essentially units; but the presumption that they are separable is on his own testimony not in accordance with Pythagorean doctrine.<sup>165</sup>

As a consequence of substantial number Aristotle deduces that Unity and Being must be regarded as substances; and so he can attribute this doctrine to Pythagoreans and Platonists alike.

<sup>163</sup> *Metaphysics* 1001 A 12-19. Cf. 996 A 7-9 and page 36, note 135. In 1053 B 9-16 the substantial Unity of Plato and the Pythagoreans is distinguished from the adjectival Unity of the physical philosophers.

<sup>164</sup> *Metaphysics* 1001 A 24-27.

<sup>165</sup> Because Aristotle does not bear in mind the nature of the Pythagorean construction of lines from corporeal units he is puzzled by an argument of Zeno which he misuses (*Metaphysics* 1001 B 6-16). If unity is indivisible it cannot exist, according to the axiom of Zeno that what, when added, does not make a thing greater or, when subtracted, make a thing smaller does not exist. Zeno assumes, says Aristotle, that whatever is has magnitude and so is corporeal; but this is not true, for indivisible things can exist. Zeno, however, was laying open the contradiction in the Pythagorean theory which Aristotle does not see. These indivisible corporeal units—the true meaning of the argument was—, if really indivisible units, cannot by agglomeration result in line or surface and, if corporeal, cannot be indivisible or units. Cf. Burnet, *op. cit.*, page 315; Hasse und Scholz, *Die Grundlagenkrise der Griechischen Mathematik*, page 11.



He has in mind particularly the Platonists, who did in fact hold the doctrine;<sup>166</sup> but he implies that, to be consistent, the Pythagoreans too must have admitted it, so that his refutation touches them also. Anyway, he proceeds,<sup>167</sup> even if there be a substantial Unity, number cannot be substance for the same reason that substantial Being precludes the possibility of a plurality of objects, for beside the substantial One there could be no other unit, and a plural number must consist of units. This method of reducing Pythagoreanism and Platonism to fundamental identity enables him to argue<sup>168</sup> that from a single unit or a number of such units magnitude cannot be constructed any more than a line can consist of points, since such a unit has no magnitude itself. The immediate context, being concerned with the Platonistic generation of number from the unit and the indeterminate dyad,<sup>169</sup> makes it easier to overlook the different character of Pythagorean numbers.

The unit of the Pythagoreans in the account of Aristotle has become deeply colored by the characteristics of the later Platonic substantial Unity and substantial Being; as Aristotle is much concerned with describing the derivation of the numbers from Unity and the Indeterminate in Platonism he attempts to do the same for the Pythagoreans. But, in one passage<sup>170</sup> where he tries to give such an account he finally confesses that the theory he is reporting is cosmogonical and does not refer to the generation of numbers. In the course of describing the early philosophies in respect of their recognition of the various types of cause he speaks differently.<sup>171</sup> And, first, he now says

<sup>166</sup> *Metaphysics* 1001 A 29-B 1. If substantial Being exists the conclusion of Parmenides is true: all things which are are one and this is Being. For the ambiguity of τὸ ὄν on which Aristotle's argument rests see Ross, *Commentary on Metaphysics*, vol. I, page 245. It was the argument of Parmenides, Aristotle says (*Metaphysics* 1089 A 2-6), that caused the Platonists to assert the existence of non-Being and to derive existing things from a combination of it with Being. This was suggested to him evidently by Plato's *Sophist* (cf. *Sophist* 237 A, 256 E); cf. page 75, note 303 (end).

<sup>167</sup> *Metaphysics* 1001 B 1-6.

<sup>168</sup> *Metaphysics* 1001 B 17-19.

<sup>169</sup> *Metaphysics* 1001 B 19-25, while B 6-16 attacks the substantial Unit.

<sup>170</sup> Pages 38-39 and page 39, note 148. <sup>171</sup> *Metaphysics* 985 B 23-986 B 8.

that the Pythagoreans conceived the *elements* of number to be the elements of things. But this passage is a reconstruction of the manner in which the Pythagoreans came by their theories, and it is not free from suspicion. For example, the counter-earth is said to have been invented merely to make the number of heavenly bodies tally with the perfect decad, an interpretation which he seems himself not to have believed.<sup>172</sup> Besides, even here the heaven is said to have been considered number itself, though the notion that things were similar to number is given as the original reason for the Pythagorean theories. Forewarned, then, we read that for these philosophers number is both the material principle and the modified conditions of things, even and odd are the elements of number, the even being unlimited (or infinite) the odd limited, the Unit consists of both for it is both odd and even,<sup>173</sup> from the unit number is derived, and the whole universe is numbers. This vague sentence is constructed as an answer to the question Aristotle has set himself: which of the four causes did the Pythagoreans recognize?<sup>174</sup> The numbers they obviously used as material; but number for Aristotle is nearer to the formal cause, and so he thinks that they dimly recognized it as such also.<sup>175</sup> Moreover, that even and odd are the *constituents* of the unit, he elsewhere<sup>176</sup> implicitly denies by setting the unlimited and the One in the same grade of substantiality and tacitly equating the unit with the limited. Nor is there here any derivation of number from the unit. He simply says that they make all things

<sup>172</sup> See Burnet, *op. cit.*, page 305.

<sup>173</sup> Cf. Aristotle, *frag.* 199, and Zeller-Nestle, *op. cit.*, I, p. 505, note 3. The reason for the designation ἀρτισπέρητον is given by Aristotle in the fragment: ἀρτῶ μὲν γὰρ προστεθὲν περιττὸν ποιεῖ, περιττῷ δὲ ἀρτιον. There is here no intimation of the derivation of the unit from these two principles; that conclusion, the fragment shows, derives from Aristotle himself, who, when it serves his purpose, identifies the Pythagorean unit with the "limited" (cf. page 226 *infra*).

<sup>174</sup> See the sentence 986 A 13-15; and notice that the sentence containing the answer reads φαίνονται δὲ καὶ οὗτοι τὸν ἀριθμὸν νομίζοντες . . .

<sup>175</sup> 986 A 17: ὡς πάθη τε καὶ ἔξεις means to imply this. (See Ross, *op. cit.*, *ad loc.*). But he wavers, at 986 B 6 saying they make the elements matter, at 988 A 26-27 giving only the ἀπειρον as the Pythagorean matter.

<sup>176</sup> *Metaphysics* 987 A 17-19.



number as a consequence of the substantiality of the unit and the unlimited, which implies that odd numbers owe their substantiality to the "limited" (not regarded as number) and the even numbers theirs to that of the "unlimited."<sup>177</sup> A comparison of this passage with the one above cited<sup>178</sup> makes it seem likely that Aristotle found no Pythagorean explanation of the derivation of number from the unit and that his intimation that it was so derived is a result of the tendency to treat Pythagoreanism and Platonism as closely related doctrines. Finally, the representation of Pythagorean number as the "cause of the substantiality of objects" is obviously meant to show that the Pythagoreans must somehow have recognized formal cause;<sup>179</sup> and the statement that the Pythagoreans made things imitate number is due to Aristotle's reconstruction of the way in which they must have arrived at a theory which he cannot take literally because he thinks it impossible for anyone to have considered the musical scale, which is merely ratio, to be numbers.<sup>180</sup>

Although Aristotle hints that the infinite of the Pythagoreans may have been corporeal and consistently represents their numbers as such when he speaks explicitly of them, his refutation of the substantiality of these concepts treats them as identical with the abstract numbers and indeterminate element of the Platonists, because throughout the critique of substance he is concerned with supporting his doctrine of substantive matter. The other Presocratics, in holding elements which were corporeal,<sup>181</sup> to this extent escape criticism. That they failed to understand the mode of that substantiality and overlooked completely substantive form are objections to be reviewed elsewhere.<sup>182</sup>

The substrate of generation must be substance; and Aristotle's criticism of Pythagoreans and Platonists is intended to

<sup>177</sup> So Alexander 47, 24-48, 9.

<sup>178</sup> Page 44, note 170.

<sup>179</sup> Page 45, note 175.

<sup>180</sup> See pages 39-40, note 155, and page 45 (cf. *Metaphysics* 985 B 31-33).

<sup>181</sup> Cf. *Metaphysics* 1042 A 6-11 and pages 36; 43, note 163.

<sup>182</sup> Cf. page 227 *infra*.

support his belief that this substance must be material, since matter may not be derivative.<sup>183</sup> But genesis and destruction occur only between terms which are contrary,<sup>184</sup> and these two considerations are used to determine the number of constitutive principles. Aristotle is eager to show that all his predecessors have recognized that the principles must be contraries; such an attempt forces him into misinterpretation and the utilization of ambiguity. In defining the sphere of metaphysical research as the concept of Being *as* Being, he defends his view that such a definition automatically places the privation of Being within the scope of the same science because contrariety is the object of a single science, the privation being comprehensible only in relation to the state of being, by the observation<sup>185</sup> that almost all thinkers have agreed in constructing existing objects and essence out of contraries. At least, he says, they make their principles contraries, as even and odd,<sup>186</sup> warm and cold,<sup>187</sup> limited and unlimited,<sup>188</sup> love and strife.<sup>189</sup> These and the principles of other philosophers, too, fall under unity and plurality as their genera. The violence done Empedocles is immediately patent, for love and strife are here treated not as the two principles of motion—in which sense Empedocles introduced them—nor even as two of the six elements,<sup>190</sup> but as

<sup>183</sup> *Physics* 190 A 31 ff.

<sup>184</sup> *Physics* 188 B 21-26; 224 B 28-35; *De Generatione* 324 A 12; 331 A 14; 335 A 7.

<sup>185</sup> *Metaphysics* 1004 B 29-1005 A 2.

<sup>186</sup> Pythagoreans. See *Metaphysics* 986 B 2-4 where from the table of contraries and the remarks of Alcmaeon, *δύο τὰ πολλὰ τῶν ἀνθρωπίνων*, Aristotle concludes that for him and the Pythagoreans the *ἀρχαί* were contraries.

<sup>187</sup> Though Alexander says this refers to "those who use rarefaction and condensation as the generating principles of things or to Parmenides," a comparison with *Metaphysics* 986 B 33-34, *Physics* 188 A 20-22, *De Generatione* 318 B 6-7, 330 B 14 shows that Aristotle has in mind the second part of Parmenides' poem.

<sup>188</sup> Those who made the One and the Indeterminate Dyad the principles (i. e. the Platonists), according to Alexander; but from what has been seen of Aristotle's tendency to confuse Platonists and Pythagoreans in regard to this set of principles it seems likely that he is here referring loosely to both groups.

<sup>189</sup> Empedocles.

<sup>190</sup> Cf. *Metaphysics* 1075 B 3-4: *αὕτη δ' ἀρχὴ καὶ ὡς κινουσα· συνάγει γάρ· καὶ ὡς ὕλη· μόνιον γὰρ τοῦ μίγματος*.

terms for the states of the universe in the two moments of the supremacy of each. Elsewhere the *Sphere* is interpreted in such a way as to put Empedocles into the class of material monists;<sup>191</sup> here the interpretation is altered to draw support for the doctrine that the contraries, particularly the contrariety of unity and plurality, are fundamental in all metaphysical theories. This causes him to interpret the second part of Parmenides' poem as the author's own theory of the phenomenal world and so to find in Parmenides also two contraries as principles.<sup>192</sup> Since his purpose at this point is merely a

<sup>191</sup> See page 36, note 135.

<sup>192</sup> Three of the four passages, beside the one considered in the text, in which this interpretation occurs are specifically directed to proving that all philosophers recognized contraries as principles (*Physics* 188 A 20, *De Generatione* 318 B 6, 330 B 14), the other attempts to prove that Parmenides was superior to Melissus and Zeno because he recognized the necessity for accounting for phenomena (*Metaphysics* 986 B 33), so that Aristotle's motives for considering the second part of the poem to be the physical doctrines of Parmenides himself are clear. In all four passages "fire" and "earth" are given as the two elements, though Parmenides calls them "fire" and "night" (Diels, *Vorsokratiker*, 18 B 8, lines 56-59 and Simplicius, *Phys.* 25, 16). Aristotle himself prefers to call them "the hot and cold" and implies that this is really what Parmenides meant. Having identified the "fire" of the poem with his own primary quality "hot," in order to assert that Parmenides, too, posited contraries, he had to suppose that the other element was what in his own terminology was called "cold." But "night" could not be equated with "cold" nor could it be considered the contrary of "fire," so that Aristotle, to maintain the argument, had to change it to earth, which was the easier to do, since of his own primary sensible bodies fire and earth are the two limiting terms. This obviates the necessity of postulating with Burnet a "later Pythagoreanism" in which fire and earth were the primary elements (*op. cit.*, p. 293), a theory which, whether right or not, can not explain why Aristotle, who takes the second part of the poem as representing Parmenides' own views and not Pythagorean theory, misquotes the text.

There is the further curiosity that Aristotle says Parmenides equated fire with Being and earth with non-Being (*Metaphysics* 986 B 34 f.; *De Generatione* 318 B 6-7). In the latter passage this equation is given as an example of the contrary limits of absolute and relative genesis and destruction. Now even if Parmenides had said that fire is Being and earth (or Night) non-Being, he could not have called the change from fire to earth "relative genesis and absolute destruction." This is a distinction of Aristotle's resting on his own notion of potentiality and privation; and the equation attributed to Parmenides is merely the usual tendency of Aristotle to read into an earlier philosopher the implication of his own doctrines. There is, then, no need to look for the source of this

justification of his definition of the scope of metaphysical research, he does not interpret more closely this presumed agreement among his predecessors; in other contexts he seeks to find in previous uses of contrariety a precedent for founding genesis and alteration upon the contrary qualities of his primary sensible bodies. Though they gave no rational explanation of the fact, all thinkers made their elements contraries, as if they were constrained to do so by the truth that they failed to recognize.<sup>193</sup> They differed in setting up principles which varied in priority and intelligibility according to abstraction, making hot and cold,<sup>194</sup> moist and dry,<sup>195</sup> odd and even,<sup>196</sup> love and strife<sup>197</sup> the causes of generation, but all these are similar in that each is a pair of contraries the terms of each of which stand to each other in a relationship of preponderance-deficiency, better-worse. In this analysis the contrariety is found in the material principles, for even the love and strife of Empedocles are used, as has been said, to designate the two states of the world at the time of complete mixture and complete segregation. Such a material contrariety cannot be read into the Ionian monistic systems; consequently Aristotle shifts his point of view with regard to them and says<sup>198</sup> that they bring about multiplicity from their single material, fire, air, water, or a substance between fire and air in density,<sup>199</sup> by means of condensa-

identification in *frag.* 8, 53 (as Ross does) or anywhere else in the text of Parmenides.

<sup>193</sup> *Physics* 188 B 26-189 A 10.

<sup>194</sup> Parmenides; cf. next note.

<sup>195</sup> Philoponus refers this to Xenophanes; the four, hot-cold-moist-dry, are probably meant to cover all the "physical philosophers" without distinction, for they fall into the class of those whose principles were γνωριμώτερα κατὰ τὴν αἴσθησιν.

<sup>196</sup> Pythagoreans. Cf. next note.

<sup>197</sup> Empedocles. Cf. pages 47-48 and note 191. Even-Odd, Love-Strife represent the principles γνωριμώτερα κατὰ τὸν λόγον. N. B. the order of the table of Pythagorean contraries in *Metaphysics* 986 A 23-26 implies that the fundamental contrariety was πέρas—ἀπειρον; Aristotle's *frag.* 200, however, represents it as ἀγαθόν—κακόν.

<sup>198</sup> *Physics* 187 A 12-20.

<sup>199</sup> It is impossible to assign this "element" to Anaximander here since he is expressly mentioned in a group set off from those here discussed (187 A 20 ff.). See pages 12, note 52; 17, note 70; 25, note 93; 54, note 215.



tion and rarefaction. These are contraries of excess and deficiency which are considered to be differentiae of the one material substrate in direct opposition to the manner in which Plato placed the contrariety in the substrate and made Unity the form.<sup>200</sup> Apart from the fact that our best authority assigns the mechanism of condensation-rarefaction to Anaximenes only,<sup>201</sup> it is clear that this style of thinking could not possibly be pre-Platonic. The whole account is a violent attempt to show that even the Ionians used contrariety as the basis of genesis and alteration.

Anaximander, Anaxagoras, and Empedocles are grouped together.<sup>202</sup> They say that existent things are both one and many and derive the contraries from the One by separation. What Aristotle calls the One and further designates as a "mixture" in the case of all three alike was essentially different for each. The "contraries" were, for Anaximander, physical ingredients of his *ἄπειρον* and were separated out from it by some kind of physical motion. But Aristotle cannot help understanding the word "contraries" in his own sense of the elemental limits between which alteration takes place; and this enables him to believe that Anaximander, too, posited such contraries as a necessary basis for generation.<sup>203</sup> The *Sphere* of Empedocles, also, is a thorough mixture of the four elements which are still the distinct constituents of it and form no new

<sup>200</sup> Cf. pages 53 to 56. The statement in the text is repeated at *Physics* 189 B 10-16 after the attempt to reinterpret ancient theories in accordance with the principle of a single material substrate acted upon by contraries. In the latter passage those who make unity the agent and duality the substrate are called *τῶν ὑστερόν τινες*. Simplicius implies that this may refer to Pythagoreans (Simplicius, 204, 16 ff.) but the parallel passage before us shows that it is Plato and the Platonists whom Aristotle has in mind.

<sup>201</sup> Theophrastus *apud* Simplicius, *Phys.* 149, 32 ff. The fact that Simplicius adds here *δῆλον δὲ ὡς καὶ οἱ ἄλλοι τῇ μανότητι καὶ πυκνότητι ἐχρῶντο* only makes the statement of Theophrastus certain, for Simplicius' reason for his correction is simply that Aristotle here seems to attribute the mechanism to others too. In *De Caelo* 305 B 6-10 Aristotle implies that Empedocles and Democritus also used this mechanism (cf. page 118 *infra*).

<sup>202</sup> *Physics* 187 A 20-26.

<sup>203</sup> See Heidel, "Qualitative Change in Pre-Socratic Philosophy," *Archiv für Geschichte der Philosophie*, XIX, p. 346.

homogeneous body. And in this case there is no reason for supposing the *Sphere* to be prior to the state of complete segregation by Strife, since both are equivalent moments in an eternally continuous process. There is, then, even less excuse for interpreting the *Sphere* as the material substrate in which the contraries inhere potentially than in so interpreting the infinite body of Anaximander or the mixture of Anaxagoras. The latter, Aristotle says, differs from Empedocles in making the separation a single process instead of periodic and in assuming an infinite number of homogeneous bodies and contraries instead of what Empedocles called the elements. The long attack on Anaxagoras which follows<sup>204</sup> is here motivated by Aristotle's displeasure with a theory which explicitly made the contraries infinite in number and so, to his mind, made generation unintelligible. He asserts that the common doctrine that nothing could arise from non-Being caused Anaxagoras to say that everything was together and that consequently the genesis of a specific thing is merely alteration. For, since contraries arise from contraries, Anaxagoras, following the view that the new object could not arise from what was not previously, supposed that the contraries must be present in each other in masses so small that they are imperceptible; so everything is a mixture of everything and each thing gets its appearance of difference from the mass which preponderates in it. Aristotle's objections to this theory are as follows: 1) It makes knowledge of anything impossible, since we know a composition by knowing its component parts and the infinite as such is unknowable.<sup>205</sup> 2) If the constitutive parts of a whole may be of any size, so can the whole thing. In the case of an animal or plant we see that there are limits to the size of the whole in both directions. Consequently the parts, such as flesh, bone, etc. are limited in size. This argument hints at the formal cause which is the limiting element in structure.<sup>206</sup> 3) If there are parts of everything in any given body and these may be separated out, such a process of separation should be able to ex-

<sup>204</sup> *Physics* 187 A 26-188 A 18.

<sup>205</sup> See page 5.

<sup>206</sup> Cf. page 23, the argument against an infinite body.



haust the parts of flesh in a limited quantity of water, in which case the general axiom will be false, or else in a finite body there will be an unlimited number of finite bodies. This argument presupposes minimal quanta, however, which Anaxagoras expressly denied. On the same assumption Aristotle also argues that in a minimal quantity of any substance nothing else could inhere since it would be smaller than the minimum. In an infinite body, on the other hand, there must be present a multiplicity of bodies each of which, though not continuous, is infinite in extent; but this is impossible. 4) Anaxagoras is right in saying that complete segregation never takes place though he is unaware of the true reason for this, which is that qualities are inseparable from their subjects; that is, they can have no substantial existence. The *voûs* which sought to bring about segregation was absurd, for without a minimal quantity and with inseparable qualities, it is both quantitatively and qualitatively impossible. Aristotle cannot remember that for Anaxagoras and his forerunners qualities were physical entities and so fails to see that the continuity of these material qualities itself caused Anaxagoras to insist that infinite division could not reduce a quality to simpler ingredients. 5) This theory creates air and water by simple synthesis, but it is better to assume a limited number of constituents as Empedocles does. Aristotle means that on the theory of Anaxagoras true genesis is impossible and that the assumption of the genesis of contraries from each other makes it possible to avoid the difficulties of an infinite number of simple bodies.

But despite their errors all have made the principles contraries,<sup>207</sup> even those who make the universe an immovable unity, for Parmenides calls the hot and cold the principles.<sup>208</sup> The same is true of those who posit the rare and dense and of Democritus who calls the plenum Being and the vacuum non-Being and says that both exist. Besides, his principles of position, figure, arrangement are themselves genera of contraries. Aristotle has elsewhere<sup>209</sup> refuted the atomic theory with the

<sup>207</sup> *Physics* 188 A 19-30.

<sup>208</sup> See page 48, note 192.

<sup>209</sup> *De Caelo* 307 B 5 ff.; see page 12.

argument that there is no contrariety in the genus of figure, but when he is hunting for contraries he finds them even in the Eleatic doctrine.<sup>210</sup> The reason why all have made the contraries principles is that the principles must not be derived from each other or from anything else but all other things must be derived from them; and these characteristics are found only in the prime contraries. This is a corollary of the Aristotelian theory of genesis from the substrate which is potentially the contraries and, as such, obviously fits no earlier doctrine; but Aristotle, in thinking that it does, reveals that he has read into all preceding philosophy his own theories of alteration.

Since the principles must combine substantiality and contrariety and so cannot be single (for a contrariety is not one) nor infinite (for Being would be unintelligible), Aristotle is now in a position to determine the exact number of constitutive elements. From the experience of history he pleads that a finite number is not only necessary but as effective as an infinite number, for Empedocles gave a better account of the world with his elements than did Anaxagoras with an unlimited number of principles.<sup>211</sup> But there must be something more than two contrary principles, for contraries cannot affect one another. Love does not draw Strife together and make something out of it nor does Strife make anything of Love, but both affect some third thing,<sup>212</sup> he says, now referring to these two terms of Empedocles as active forces and not, as previously, to designate two conditions of the material of the universe; and now he begins to treat the contraries, which he recognized before in the material constituents of other theories as well as in principles of energy or both, as agencies of alteration only and to look for true matter apart from them. But still he claims to find this new attitude in the Presocratics; some even sought a multiplicity of elements to play the rôle of matter in this sense.<sup>213</sup> This refers to the four elements of Empedocles and to

<sup>210</sup> In *Metaphysics* 1075 B 11-13 Aristotle complains that his predecessors do not use the contraries which they posit unless one rearranges their doctrines for them.

<sup>211</sup> *Physics* 189 A 14-17.

<sup>212</sup> *Physics* 189 A 24-26.

<sup>213</sup> *Physics* 189 A 26-27.



the infinite atoms of Democritus, although shortly before he made the atoms one term in the contrariety which he claimed was posited by that theory.<sup>214</sup> It was in order to get a substrate separate from the contraries that certain thinkers made the universe of a single substance, as water, fire, or something intermediate.<sup>215</sup> Since the four elementary bodies, however, are themselves complexes of contraries, an intermediate body would suit the requirements best, while air, having perceptible differentiae to a smaller degree than fire, water, and earth, would be the most suitable of the four so-called elements. But, anyway, all who did consider the primary body as one used a pair of contraries, reducible to the concept excess-deficiency, to fashion this substrate. In this way Aristotle has transformed the element of the material monists into a single material substrate which is informed by contrary qualities and so has imported into these theories the prototype of his own potential matter and immaterial qualitative contraries. He cannot

<sup>214</sup> *Physics* 188 A 22-23; see page 52.

<sup>215</sup> *Physics* 189 A 34-B 16. Simplicius, *ad loc.*, refers τὸ μεταξὺ τούτων to Diogenes; since τούτων refers to water and fire, the phrase could include air which seems to have been the principle of Diogenes (*frags.* 4; 5; and Simplicius, *Phys.* 25, 4-9), although Aristotle means something apart from the four elements by τὸ μεταξύ (cf. below 189 B 3-6). It would be possible to consider it a reference to Anaximander's ἀπειρον; but the identification of Simplicius which was that of Nicolaus (cf. Simplicius, *Phys.* 25, 8-9) may have found support in such phrases of Diogenes as ὁ ἀήρ καλούμενος ὑπὸ τῶν ἀνθρώπων (*frag.* 5, 1-2) which could be made to imply that Diogenes considered his principle to be not ordinary air but something to which the term ἀήρ was extended, though wrongly, by men, perhaps a purer, less dense state of the principle than that found in the atmosphere of the earth. Warmth varies directly with rarity for him; and the purest air, in his sense of principle, would be that state of density and warmth midway between water and fire. Air in this state is the soul, which is warmer (and rarer) than the atmospheric air, colder (and denser) than the air about the sun where the element is on the point of passing from air to fire (cf. *frag.* 5, 12-13). Diogenes, then, made the principle not air in a general sense, but that air which was midway between water (or vapor) and fire, at the point where it was in fact the soul. (In this manifestation it may vary in warmth but only very slightly—*frag.* 5, 14-16.) But whether Aristotle was aware of this and means Diogenes here is uncertain. At *Metaphysics* 984 A 5 f. he says Diogenes made air the principle. Cf. page 49, note 199 and the references there; on the other side cf. Ritter and Preller, *Historia Philosophiae Graecae*<sup>9</sup>, § 211 b, c and Zeller-Nestle, *op. cit.*, I, pp. 341 ff.

then escape the conclusion that they meant by differentiation alteration in the sense in which he uses it also. With even more violence he has reduced the mechanical mixtures of Anaxagoras and Empedocles to equivalents of his own potential matter and, in the case of the latter, has interpreted the elemental bodies as contrary qualities,<sup>216</sup> though the principle which he at one time identifies with his substrate<sup>217</sup> he at another makes one of the contraries.<sup>218</sup> In conformity with this accommodation he makes all the material monists posit a single principle as a material substrate and use two contraries as the active principles of differentiation.<sup>219</sup> It is clear that Anaximander's "separation" was not condensation and rarefaction<sup>220</sup> and that neither his "contraries" nor those of any of the Presocratics were a single set of opposed agencies but an indefinite number of physical ingredients.<sup>221</sup> But Aristotle read into the word "contraries" all the implications for alteration which that concept had in his own terminology. This is why he tries to equate the terms rare and dense with hot and cold which form the active contrariety in his physics,<sup>222</sup> for he requires qualitative alteration of the substrate such as heat and cold can, according to his theory, produce and not merely quantitative change which "rare" and "dense" imply.<sup>223</sup> And in order to impute the principle of alteration to all the Ionian theories he must find in all a set of contraries; therefore, he extends the mechanism of Anaximenes to all the rest. As for those who posit two principles, as Parmenides does fire and earth,<sup>224</sup> they make

<sup>216</sup> See pages 50 and 51, *Metaphysics* 1053 B 15-16 (cf. page 36, note 135).

<sup>217</sup> Explicitly, for example, in *Metaphysics* 1069 B 21-23.

<sup>218</sup> *Metaphysics* 1004 B 31-33; see pages 47-48. The same variation of accommodation occurs in the interpretation of the Atomists, cf. page 54, note 214.

<sup>219</sup> *De Generatione* 330 B 7-13.

<sup>220</sup> See pages 50, note 201; 50, note 203.

<sup>221</sup> This is implied by Aristotle himself in *Physics* 187 A 23: ἐκ τοῦ μίγματος γὰρ καὶ οὗτοι ἐκκρίνουσι τὰλλα. Cf. Heidel, *op. cit.*, pp. 345-6 and note 29.

<sup>222</sup> *De Generatione* 329 B 24-32.

<sup>223</sup> Therefore he thinks that these early theorists must have regarded condensation-rarefaction as qualitative changes, though he knows they are quantitative (*Categories* 10 A 16 ff.), for genesis requires alteration of the substrate (*Physics* 246 A 6 ff.). Cf. *De Generatione* 329 A 5-8.

<sup>224</sup> *De Generatione* 330 B 13-19; see page 48, note 192.



the intermediate bodies, air and water, mixtures of these two, while those who set up three elements<sup>225</sup> do much the same, only leaving the middle term single whereas the others divide it into two. Here again the difference between the contrariety of the monists and that of the pluralists is disregarded. The former was found in the agencies, the latter exists in the material principle. The sole purpose is to make a single pair of contraries the principle of all philosophies; and that purpose alone explains the statement that Empedocles, though he posits four principles, contracts them into two, setting fire off against all the other three.<sup>226</sup> Empedocles emphatically says that his primary bodies are all equal and each has its separate office;<sup>227</sup> Burnet<sup>228</sup> suggests that the importance of fire in the cosmogony and biology of Empedocles gave Aristotle this false notion; but fire or heat is fully as important in Aristotle's own biology, and the previous analysis of his accommodations justifies the belief that it is rather the desire to find a single pair of contrary principles in the material of all theories which impels Aristotle to this interpretation.<sup>229</sup>

The word, contraries, wherever found, involved for Aristotle the notion of generation and alteration;<sup>230</sup> and this, in turn, required a subject of alteration. The qualities are for him simply predicables whose only possible mode of existence is the grammatical relationship of predicate to subject. This subject, as substance, has no contrary term and, as that of which there are predicables but which itself is predicable of nothing else, is

<sup>225</sup> On the reference to Plato here see Joachim's *On Coming-to-Be and Passing-Away*, pp. 214-217. Ion of Chios set up three elements presumably (cf. Diels, *Vorsokratiker*, 25 B 1). The Pythagorean axiom cited in *De Caelo* 268 A 10-15 τὸ πᾶν καὶ τὰ πάντα τοῖς τριῶν ὥρισται has nothing to do with physical principles, but its reference to beginning-middle-end may be in Aristotle's mind here.

<sup>226</sup> *De Generatione* 330 B 19-21, the same remark occurs in *Metaphysics* 985 A 31 ff., but cf. *Metaphysics* 984 A 8-11.

<sup>227</sup> Diels, *Vorsokratiker*, frag. 17, lines 27-28.

<sup>228</sup> *E. G. P.*<sup>3</sup>, p. 231.

<sup>229</sup> It is significant that in this passage the statement bears no element of adverse criticism, for Aristotle is maintaining that his predecessors were right in positing a single contrariety; but in its context in the *Metaphysics* it sounds like a detraction.

<sup>230</sup> *Metaphysics* 1087 A 29-B 3. Cf. *Physics* 190 A 31-B 5.

prior to the contraries.<sup>231</sup> Consequently, the substrate is the principle in the full sense of the term, the contraries only secondarily. This persistent substrate which changes from one state to its contrary must be capable of becoming both; it is that from which as potential existence and actual non-existence all things come to be. Such a substrate he purports to find in the original mixture of Anaxagoras, the *Sphere* of Empedocles, the limitless body of Anaximander, and the unorganized atoms of Democritus.<sup>232</sup> "All things were together" he interprets as meaning that the individual alterations were inherent in an undifferentiated material, a notion clearly foreign to all four philosophers but for Aristotle consequent upon his reading into all their doctrines the theory of alteration in his own sense.<sup>233</sup> They should have made this clearer, he objects, by saying that "all things were together potentially but not actually." Besides, to say that "all things were together" is insufficient, for the infinite things that came to be are differentiated by their matter, and, since the cause of differentiation which Anaxagoras calls *νοῦς* is one, what things have come to be actually their original matter must have been potentially. That is, the original matter must have had potentially contrary qualities, which stand to this potential matter as formative state and privation.<sup>234</sup>

So he interprets these theories when he is seeking in them indications of his own doctrine of the material principle, but in the essay on Generation he has another purpose, namely, to show that this primary matter cannot be characterized as any one hitherto has characterized it. Still, the whole foundation of the argument is the assumption that the earlier philosophers

<sup>231</sup> Cf. *Physics* 189 A 27-34.

<sup>232</sup> *Metaphysics* 1069 B 18-32. On the text see Ross's *Commentary*, II, pp. 350-352.

<sup>233</sup> See Heidel, *op. cit.*, p. 374 and note 125; and pages 49-50 *supra*.

<sup>234</sup> The connection of this physical doctrine with the grammatico-logical doctrine of subject-predicate—in which the predication of one quality implies the predication of the negative of its contrary and in which subject-predicate, though inseparable in fact, are separable in essence—is clearly brought out by Aristotle's use of it in refuting the ontology of Parmenides and his followers. (Cf. *Physics* 186 A 28-32, 187 A 3-6.)

were seeking a substrate for alteration between the terms of a limited number of contraries.<sup>235</sup> If this is the nature of alteration, no one of the four simple bodies can be the material principle,<sup>236</sup> for, as such, it will persist in the various states; and, while no one supposes that it is simultaneously any two of the bodies, the change of the substrate will be an alteration of a persisting sensible body and not genesis of one from another. Such alteration implies, however, that the resulting body possesses a quality contrary to that of the substrate; for example, if fire results from an alteration of the substrate air, fire will be hot air. But experimentally fire cannot be produced by alteration of air; and, besides, if this were a true description of the process, fire would be both hot and cold, hot, as fire, and, as air, cold, the other limit of the contrariety. This shows that there must be some common material principle of the four simple bodies.

This cannot, however, be a sensible body apart from these four, intermediate between air and water or air and fire,<sup>237</sup> for if with the addition of one term of a contrariety it becomes air or fire, its original state implies privation of that quality. But, for a substrate capable of information by one contrary quality, the privation of that quality necessitates information by its contrary; so that such a body cannot exist in isolation as some say the infinite body that surrounds the world does.<sup>238</sup> His objection to such a theory attacks not the hypothesis of a material principle apart from the four simple bodies but the notion that that principle is actually separable from them; as such it would be endowed with sensible qualities and so be equivalent to the air of Anaximenes or the fire of Heraclitus.<sup>239</sup> This criticism, then, is fatal to such theories as claim to generate all bodies from a single sensible body or from two or three,<sup>240</sup>

<sup>235</sup> For the doctrine see *Physics* 225 A 12-20, *De Generatione* 319 B 6-320 A 7.

<sup>236</sup> *De Generatione* 332 A 6-20.

<sup>237</sup> *De Generatione* 332 A 20-26.

<sup>238</sup> This type of theory certainly includes that of Anaximander, but the reference seems clearly not to be exclusively to one theory. Cf. page 54, note 215, and the references there.

<sup>239</sup> *De Generatione* 329 A 8-13.

<sup>240</sup> *De Generatione* 328 B 33-329 A 2. Fire and earth evidently refer to

since Aristotle assumes that the theories which posit two elements or three use them as extreme and middle terms in the contrariety of alteration.<sup>241</sup> Empedocles represents a different system, for he treats the four simple bodies as equally primary and explains genesis and destruction as a combination and segregation of these elements.<sup>242</sup> Such a system does away with genesis and seeks to account for all bodies on the analogy of a mosaic; but flesh and all homogeneous bodies defy such an interpretation,<sup>243</sup> for any section of such a body may be converted indifferently into fire or water; though, if it were a mechanical mixture of tiny bits of the four elements, themselves unalterable, dissolution of any homogeneous body should result simply in segregation of the inherent constituents. The direct argument against the irreducibility of the primary sensible bodies proceeds from the apparent observation of the quenching of fire on the one hand and the impossibility of an atomic body on the other.<sup>244</sup> If phenomenal alteration be an infinite process, it requires an infinite time for completion; but that would mean that synthesis of an element, too, is an infinite process requiring infinite time; this posits the absurdity of two infinities. If alteration be a finite process, either the simple bodies must be subject to complete dissolution or there must be an arbitrary point at which the process is checked. But this requires either atomic bodies—already proved to be impossible—or bodies which, though divisible, are never actually divided. This last seems to Aristotle to be the thesis of Empedocles; but it seems absurd because if a large quantity of a given element is dissolved it is only reasonable that a smaller quantity of the same element should be more easily dissolved. And this Aristotle tries to prove from the observation that of the two ways in which fire is destroyed, being quenched by its opposite and waning by itself, the smaller the amount of fire

Parmenides once more (see page 48, note 192); the three elements seem to be those of Ion of Chios (see page 56, note 225).

<sup>241</sup> See pages 55 ff.

<sup>242</sup> *De Generatione* 329 A 2-8.

<sup>243</sup> *De Generatione* 334 A 18-21, 334 A 26-B 2.

<sup>244</sup> *De Caelo* 304 B 23-305 A 14.



the more speedily it succumbs to both. The result of this criticism is that Empedocles is found to be, in effect, an Atomist; and hereafter he and Democritus are treated together as being incapable of accounting for genesis.<sup>246</sup> This is much nearer the truth than the other interpretation which supposes that Empedocles held the Aristotelian theory of alteration from contrary to contrary and so contradicted himself.<sup>246</sup>

Aristotle's dominant reason for making the simple bodies change into one another is the necessity of vindicating the eternity of the world of change in the face of the doctrine of natural motion which, if untempered by this means, would segregate the simple bodies and bring them to perpetual rest immediately.<sup>247</sup> The hypothesis of a material substrate is necessary for this interchange; but this substrate must not itself be a sensible body apart from the other four lest it, too, have a natural motion as its essential quality. Therefore it appears always in connection with a pair of qualities as one of the four simple bodies and this leads to the distinction between absolute genesis and alteration, the former being the alteration restricted to that material which exists only potentially. The contrary qualities cannot change in any way; but by informing potential matter as state and privation they bring about the genesis of the simple bodies which because of these qualities are themselves in a sense contraries.<sup>248</sup> Since these qualities occur only as informing primary matter, that is, only paired under the form of the simple bodies, all alteration of character in more complex bodies is due to the genesis and destruction of the primary sensibles, so that a denial of such genesis with Empe-

<sup>246</sup> E. g. *De Caelo* 305 B 1 ff. See page 16 for the attempt to reduce Heraclitus to the doctrine of Atomism.

<sup>248</sup> Cf. Heidel, *op. cit.*, pp. 366-7 and the passages quoted by him in note 107 *ibid.*

<sup>247</sup> See page 10, note 40.

<sup>248</sup> *De Generatione* 329 A 24-B 6. See *Metaphysics* 1075 A 28-31 where he criticizes all his predecessors for creating everything of contraries, for some things are not generated (i. e. the eternal substance) and for such as are a third principle is necessary inasmuch as contraries cannot be directly affected by each other.

docles amounts to the denial of the possibility of all or any alteration.<sup>249</sup>

Burnet assumes<sup>250</sup> that the immaterial opposites, hot-cold, moist-dry, were traditional and that Empedocles arrived at his "four roots" by making each of these opposites a *thing* in the full Parmenidean sense. But the immateriality of the opposites is clearly an Aristotelian notion, a consequence of the necessity of a common substrate for the "elements" of Empedocles. Aristotle had then to make these elements qualifications of that substrate; and he tended thereafter to interpret previous mention of the cold, the dry, etc., in his own sense of pairs of contrary qualifications.

At the commencement of the *Physics* Aristotle identifies the methods of physical and ontological science with respect to the establishment of their principles; his point of departure in this matter is clearly Plato's *Sophist*,<sup>251</sup> and the importance of the analysis of non-Being in that dialogue not merely for Aristotle's logic but also for his physics is emphasized by his criticism of Heracliteanism and Eleaticism in the passages in which he attributes the desperate results of those doctrines to a misunderstanding of the concept of non-Being. Generation implies an abiding substrate and a pair of contrary qualities, the presence of one of which in the substrate requires the actual absence but potential presence of the other. Since privation of a given quality coincides with the present potentiality of that quality, Aristotle feels that the generation of an existent thing from Being and from non-Being is explained<sup>252</sup> and that the difficulty of the Eleatics was due simply to their misunderstanding of the relative sense of non-Being, that is, *accidental* non-Being which is equivalent to privation.<sup>253</sup> Because<sup>254</sup> they interpreted

<sup>249</sup> Cf. *De Generatione* 314 B 17-26.

<sup>250</sup> E. G. P.<sup>8</sup>, p. 228.

<sup>251</sup> Aristotle, *Physics* 184 B 22 ff.; Plato, *Sophist* 242 C 4 ff.; cf. page 2 *supra*

<sup>252</sup> *Physics* 190 A 21-31.

<sup>253</sup> *Physics* 191 B 13-16; the logical foundation of this theory is given in Plato's *Sophist* 258 A 11-E 3 where it is opposed to the attitude of Parmenides.

<sup>254</sup> *Physics* 191 A 23-191 B 34. Simplicius, 235, 18 ff., thinks this is meant to include, beside the Eleatics, Anaximander, Anaxagoras, Democritus, and Empedo-

Being and non-Being only in an absolute sense, they were forced to deny the possibility of generation and destruction, for what comes to be must be generated from Being or from non-Being and both are impossible processes. From this they drew the further consequence that there is no multiplicity but only Being itself. They were right in saying that nothing can arise from non-Being in an absolute sense, but wrong in supposing that such is the only sense in which generation from non-Being has meaning; for there is generation from privation, which does not inhere in the result of the generation; and privation is in itself non-Being.<sup>255</sup> This is generation from non-Being incidentally; and in the same way generation takes place incidentally from Being, for the Eleatics were right too in saying that in an absolute sense there can be no generation of Being from Being. A new substance arises from what *is other* and what *is not the same* as itself.

The notion of generation is made intelligible not only by the conception of privation but also by that of potentiality and actuality.<sup>256</sup> For Aristotle the concepts of privation and potentiality are combined in his theory of original matter as the substrate. As soon as the nature of substrate is understood, he says, the difficulties are resolved which caused the Eleatics in their ignorance to deny genesis, destruction, and change in general.

The Eleatic thesis so far as the physicist is concerned is refuted by experience, and it is not the business of a treatise on any particular science to refute those who deny the principles or axioms of that science.<sup>257</sup> With this exposition and the re-

cles. 191 A 31-33, however, can refer only to the Eleatics; and the preceding lines give the argument which Simplicius elsewhere (*Phys.* 103, 15-20) attributes to Melissus. Aristotle does convict *all* the Presocratics of failing to account for genesis; and in the final analysis they failed because they did not understand the nature of substrate. But here he has only the Eleatics in mind as 191 B 31-33 (*καὶ ὅλως μεταβολήν*) conclusively shows.

<sup>255</sup> But privation is itself treated as a positive reality in *Physics* 193 B 19-20, 201 A 3 ff., *Metaphysics* 1071 A 8-10. In the present passage the privation is that from which as *προϋπάρχον* the new substance arises and which *then* is not *ἐνυπάρχον* (cf. 190 A 21-23).

<sup>256</sup> Cf. *Metaphysics* 1017 A 35-B 9, 1047 A 20-29.

<sup>257</sup> *Physics* 184 B 25-185 A 14.

mark that Parmenides and Melissus proceed from false premises to argue illogically Aristotle has really excluded a discussion of their doctrine from the *Physics*. Yet he immediately introduces a long refutation of the Eleatic thesis on the ground that, although it is not concerned with physics, it results in difficulties which are physical.<sup>258</sup>

The criticism of the Eleatic unity of Being is highly instructive for the study of the method by which Aristotle built up his own doctrine of matter; and the very inclusion of the critique in the *Physics* shows that he was conscious of the logical character of the origin of his theory.

He first attacks the concept of Being from the point of view of the categories,<sup>259</sup> showing that, if it is substance, quality, *and* quantity, it is many and, if it be all quantity or quality, the axiom that only substance is separable is violated. The truth of this principle is indicated by the fact that everything is predicated of substance as subject, an example of the grammatical orientation of Aristotle's thought which determines the whole passage.

Since Melissus called Being infinite, he must have considered it to be a quantity since this is the category in which infinity occurs;<sup>260</sup> and, if it is both substantial and quantitative, it is two, not one; while, if it is substantial alone, it cannot be infinite or have any magnitude.

Since the notion of the unity of Being collides with the doctrine of the categories, Aristotle next examines the possible meaning of "one" as applied to Being.<sup>261</sup> Of the three possible interpretations of Eleatic unity—continuity, indivisibility, unity of definition or essence—the first would result in multi-

<sup>258</sup> *Physics* 185 A 17-20. Cf. *De Caelo* 298 B 14-24 where the Eleatic doctrine is rejected as unphysical. But the origin is differently explained. The Eleatics were the first to see that knowledge requires the existence of immutable substances; but, thinking that sensible objects alone existed, they applied to them the arguments concerning objects of thought. Aristotle derives this account by a literal interpretation of Plato, *Parmenides* 135 B-C. But cf. *Sophist* 249 B-D.

<sup>259</sup> *Physics* 185 A 20-B 5.

<sup>260</sup> Cf. page 23, note 85, ¶ 2 *supra*.

<sup>261</sup> *Physics* 185 B 5-186 A 3. Cf. for the different meanings of "things called one in and for themselves," *Metaphysics* 1015 B 36-1017 A 2.



plicity since the continuous is infinitely divisible and would also raise the question concerning the part and the whole, for discontinuous parts taken in themselves, if identical with the whole, would be identical with one another. If this unity be that of indivisibility, there will be no quantity or quality and Being will be neither infinite with Melissus nor finite with Parmenides. And, if the unity is unity of definition, the Eleatics will arrive at the conclusion of Heraclitus that all things are identical, and their theory will be concerned not with the unity of Being but with its non-existence and the identity of quality and quantity.

Influenced by the Eleatic teaching Lycophron<sup>262</sup> avoided the copula and others sought to rearrange their manner of speaking lest by the use of predicate adjectives they should make the one many. Since they took "one" and "being" to have only a single meaning, they failed to see that things can be many by definition or division and so were forced in desperation to admit that the "one" is "many" without understanding that, as "one" can exist both potentially and actually, such a conclusion is not necessarily an attribution of contradictory terms to the subject.

This account implies that at first an attempt was made to meet the Eleatic objection, that the same thing could not be one and many, by avoiding the copula and rephrasing propositions but that finally the recognition that no such shifting could avoid the difficulty resulted in the thesis that the one is many in the sense that every subject has contradictory properties. The charge, then, that the Eleatic unity of Being in the sense of unity of definition amounts to the Heraclitean doctrine of the identity of contradictories rests upon what Aristotle understands as the historical development of the Eleatic thesis. Yet his own account of the sophistic difficulty represents the development as being first an attempt to avoid the conclusions of the Eleatic argument and, when this failed, finally a flat contradiction of them. The connection of the sophistic tendency with the Eleatics is borrowed by Aristotle from Plato;<sup>263</sup>

<sup>262</sup> Cf. Zeller-Nestle, *op. cit.*, I<sup>6</sup>, p. 1369, note 1.

<sup>263</sup> *Phaedrus* 261 A 7-E 4; *Sophist* 259 C 1-E 6. The latter passage implies

but Aristotle disregards the other tendency of Plato to absolve Parmenides from the charge of relativism by deriving relativistic epistemology and logic as a necessity from physical theories of flux.<sup>264</sup>

The criticism which Aristotle offers of the Eleatic thesis in general is directed against Being as a unified concept in the physical world.<sup>265</sup> The argument from the categories is essentially that which was used against the possibility of a substantial infinity,<sup>266</sup> an argument based on the grammatico-logical relations of physical objects: as self-existent it can be only substance and, if only substance, it can have no predicates. The Eleatic Being, however, is just this; and even the infinity attributed to it by Melissus is really a negation of spatial determination, not—as Aristotle takes it—a positive predication of unlimited, continuous extension.<sup>267</sup> The physical character of the critique is further emphasized in the refutation of the unity of Being. Indivisibility of Being would prevent it from being a quantum and continuity would prevent it from being a unity; but that Parmenides did not use the words *ἀδιαίρετον* and *συνεχές*

that Parmenides is the source of all sophistry. Cf. my paper "Parmenides and the 'Parmenides' of Plato," *A. J. P.*, LIII (1932), p. 125.

<sup>264</sup> *Theaetetus* 152 D 2 ff.

<sup>265</sup> For a thorough-going attack on Aristotle's criticism of the Eleatics cf. P. Natorp: "Aristoteles und die Eleaten," *Philosophische Monatshefte*, XXVI (1890), pp. 1-16, pp. 147-169. Natorp's criticism is fundamentally weakened by his dogmatic assertion of the true meaning of the Eleatic doctrine. This he says was essentially the insistence upon the sole reality of transcendental Being. E. g. ". . . so verlangt der eleatische Philosoph, dass alles Sein, so vielfach und wechselnd es erscheinen mag, auf eine unwandelbare Einheit des wahren Seins bezogen werde" (p. 5); "Sie dachten sich ein allgegenwärtiges Hier und ein ewiges Jetzt; d. h. ein solches Sein welches über alle endlichen Relationen des Raumes und der Zeit überhaupt hinausliegt, gleichwohl aber, oder ebendarum, eine ungebrochene Einheit, eine absolute Totalität darstellen sollte . . ." However plausible this interpretation may be, there is unfortunately not enough direct evidence that it represents exactly the meaning of Parmenides. This dogmatism, however, should not blind one to the many apposite analyses and refutations of Aristotle's criticism made in Natorp's article.

<sup>266</sup> *Physics* 204 A 8-34; cf. pages 24 ff. *supra*.

<sup>267</sup> Cf. Natorp, *op. cit.*, p. 7; it is not necessary to go so far as to say that in speaking of Being in this way Melissus had succeeded in divorcing the concept from all materiality. Cf. page 73, note 298 *infra*.

in relation to extension a glance at fragment VIII, lines 22-25 will show, for Being is there *συνεχές* just because it is *οὐ διαίπετον* and it is *αἰδιώπετον* because it is homogeneous. That is, within itself Being (and it matters not whether we consider it as conceptual or material and spatial in respect to this argument) is always and everywhere of like intensity; there is no gap of non-Being, no less or more. So clearly in fragment VIII, line 6 *συνεχές* refers to the uninterrupted and unalterable intensity which is ever present and so precludes the possibility of past or future. The difficulty of the part and the whole shows vividly the difference between Plato's attitude to the Eleatic Being and Aristotle's, for the latter raises the physical difficulty of the identity of discontinuous parts whereas Plato<sup>268</sup> treats the unit of Being as a logical concept and argues that as a unit it presupposes another concept, Unity. In fact Plato's whole critique of Parmenidean Being is on the plane of logic; his purpose is to show that the concept of pure Being is fraught with as many difficulties as that of non-Being and that the two are necessary complements in thought.<sup>269</sup> Aristotle, on the other hand, whether he considered the Eleatic One to be material or not,<sup>270</sup> raises difficulties which would follow upon its physical application and feels that in this way the logical basis of the doctrine is overthrown.

The refutation of the unity of Being as unity of essence depends upon application to the phenomenal world also. But the whole burthen of Parmenides' poem is the non-existence of phenomena as such; phenomenal difference he does not deny, but he insists that the shiftings of phenomena prove that

<sup>268</sup> *Sophist* 245 A B.

<sup>269</sup> *Sophist* 246 A 1; 258 A 11 ff. It is evidently this difference of treatment afforded the Eleatics by Plato which makes Natorp, *op. cit.*, pp. 13 ff., decide that the Eleatic doctrine's real meaning is that quality and quantity are both phenomenal manifestations of the one law of Being.

<sup>270</sup> *Metaphysics* 986 B 18 ff. shows that Aristotle felt Parmenides may have had something more than a purely physical theory in mind. Besides, his occasional tendency to treat the second part of the poem of Parmenides as Parmenides' own physical theory (cf. page 48, note 192 *supra*) must have made him consider the first part in something other than a purely physical light.

these are not truly existent.<sup>271</sup> The identity of Being is no identity of contradictories, as Aristotle assumes it is, for what *is truly* has no other characteristic save Being. Aristotle's reduction of Eleaticism to the relativism of the Heraclitizing sophists is in contradiction to the interpretation of Plato already cited<sup>272</sup> and is due to the derivation of the sophistic treatment of the proposition from the Eleatic dialectic.

The general critique of the Eleatics<sup>273</sup> is followed by a special refutation of Melissus and Parmenides. Melissus is first accused of illogical thinking<sup>274</sup> in arguing that, as all that has come to be has a commencement, what has not been generated has none and in understanding this commencement as attaching to the object generated and not to the time of generation.<sup>275</sup> The passage of Melissus against which Aristotle directs this criticism is given us by Simplicius,<sup>276</sup> so that, as Burnet says, we are "quite entitled to understand it for our-

<sup>271</sup> *Fragment VIII*, lines 38-41.

<sup>272</sup> *Theaetetus* 152 E.

<sup>273</sup> Ross in his note on *Metaphysics* 986 B 19 implies that "the One as continuous and indivisible" refers to Melissus, "the One as unity of definition" refers to Parmenides. The appearance of *συνεχές* and *οὐ διαίπετον* in Parmenides, the argument of "the part and the whole" in Plato's *Sophist* directed against Parmenides, and the express words of *Physics* 185 B 17-18, as well as the *αὐτοῖς* of 185 B 21 and 24 show that no division of the arguments can be made between Parmenides and Melissus.

<sup>274</sup> *Physics* 186 A 8-22.

<sup>275</sup> The arguments are given at greater length in three passages of *Sophistici Elenchi*. 167 B 12-20: Melissus assumes that the universe is ungenerated, since nothing could arise from non-Being. Since what is generated has a beginning, the universe as ungenerated has no beginning and is, therefore, *ἀπειρον*. But it does not necessarily follow that if all that is generated has a beginning, anything that has a beginning is generated. Here Aristotle attacks only the conversion: all that is generated has a beginning . . . the ungenerated has no beginning. But he assumes a substitution of *ἀπειρον* for *οὐκ ἔχον ἀρχήν* in 181 A 27-30 where the argument is given as an example of the fallacy from the consequence of contradictories. The "double fallacy" is more clearly pointed out at 168 B 35 ff. where Melissus is said to have identified "the generated" with "that which has a beginning" and to have argued on the premise that "the generated" and "the spatially finite" are the same in having a beginning (*ἀρχή*).

<sup>276</sup> Simplicius, *Phys.*, p. 109, 20 ff.; Diels, *frag.* II; Simplicius, *Phys.*, p. 103, 15 ff.



selves." Burnet<sup>277</sup> admits the first conversion but says that the belief in the eternity of Being was founded rather on his whole conception of reality than on this argument. The second objection he thinks unfounded, for he interprets the word *ἄπειρον* as meaning without limit temporally not spatially. Simplicius<sup>278</sup> thought that for Melissus subject and predicate in this proposition were identical; in that case the syllogism is saved but becomes merely expository. Natorp<sup>279</sup> argues that the conversion is not false, provided B be not any optional predicate but be exclusively true of A. Aristotle himself admits the conversion to be false only if the predicate is related to the subject as an accident;<sup>280</sup> and it is clear that for Melissus the essential characteristic of τὸ γινόμενον was ἀρχὴν ἔχειν and that this was an exclusive predicate of the generated. An ἀρχή is necessarily an ἀρχή γενέσεως and to prove that there is no becoming is to destroy the possibility of an ἀρχή, as Aristotle himself says.<sup>281</sup> Burnet seeks to defend Melissus against Aristotle's reproof that he passed from beginning in time to beginning in space basing his argument that eternal Being must be infinitely extended on the equivocal use of ἀρχή; this defense consists in translating *ἄπειρον* of *fragment II* as "without limit," i. e., temporally unlimited. He supports this interpretation by noting that in *fragment III* when Melissus refers to spatial infinity he is careful to say "τὸ μέγεθος ἄπειρον."<sup>282</sup> Yet in *fragments IV, VI, VII* the bare word *ἄπειρον* means "spatially infinite" and is so translated by Burnet. The argument of Melissus was by Gorgias understood to deduce from the eternity of Being its spatial infinity;<sup>283</sup> so that we cannot suppose that

<sup>277</sup> Burnet, *E. G. P.*<sup>3</sup>, pp. 324-5.

<sup>279</sup> Natorp, *op. cit.*, pp. 147-151.

<sup>278</sup> Simplicius, *Phys.*, p. 108, 30 ff.

<sup>280</sup> *Sophistici Elenchi* 168 B 33-34.

<sup>281</sup> *Physics* 185 A 3-5 against the Eleatics. Lest it be thought that equivocation is present in this argument, it must be noted that Aristotle himself uses ἀρχή in an apparently equivocal sense, the principles of physical science and the principles of becoming. Yet, as he says ἡ γὰρ ἀρχὴ τινὸς ἢ τινῶν. In a static and eternal system there can be no ἀρχή in any sense, for the only reality is the *state* of Being.

<sup>282</sup> Burnet, *E. G. P.*<sup>3</sup>, p. 325, note 4.

<sup>283</sup> Sextus, *adv. math.*, VII, 69: τὸ γὰρ γινόμενον πᾶν ἔχει τιν' ἀρχήν, τὸ δὲ αἰδίον ἀγένητον καθεστὼς οὐκ εἶχεν ἀρχήν. μὴ ἔχον δὲ ἀρχήν ἄπειρόν ἐστι. εἰ δὲ ἄπειρόν

Burnet is correcting a misinterpretation peculiar to Aristotle but an interpretation which seemed plausible to the contemporaries of Melissus himself. Finally, Burnet's interpretation of *fragment II* results in a translation which is a tangle of circular arguments of the kind Aristotle would never have let pass unchided.<sup>284</sup>

We must conclude that Aristotle was verbally correct in saying that Melissus used ἀρχή in the double sense of "spatial starting point" and "temporal beginning" and that Melissus somehow tried to prove a connection between eternity and infinity. A correct analysis of *fragment II* will demonstrate his method.

"Since, then, it (i. e. Being) was not the result of a process,

- 1) It is and always was and always will be
- 2) And has no beginning or end but is infinite,
  - a) For, had it been the result of a process, it would have a beginning (because it would at some time have been at the commencement of the process)<sup>285</sup>

ἐστιν, οὐδαμοῦ ἐστίν. κτλ. Cf. *De Melisso Xenophane Gorgia* 979 B 21 ff.:—καὶ εἰ μὲν ἀγένητον, ἄπειρον αὐτὸ τοῖς τοῦ Μελίσσου ἀξιώμασι λαμβάνει· τὸ δ' ἄπειρον οὐκ ἂν εἶναι πού.

<sup>284</sup> Burnet's translation results in the following analysis:—*It is eternal and without beginning and end,*

A. Because it has not come to be but is was and shall be, for

1. Had it come to be, it would have beginning and end;
2. If it did not begin or end but is, it is without beginning or end, for
  - a) Nothing can always be (2) without all being.

What connection the last statement has with the argument I cannot see. Diels' translation (he takes *ἄπειρον* = spatially infinite) makes better sense; but the last and first sentences are mistranslated, I believe, and the translation avoids criticism by taking refuge in an ambiguous "literalness." (The new translation of Kranz [*Fragmente der Vorsokratiker*<sup>5</sup>, pp. 268-9] gives a more nearly exact version of the first sentence but is not otherwise essentially different from that of Diels.) Natorp, *op. cit.*, rightly sees that Melissus understands becoming as a process having temporal and spatial dimensions; but he fails to give any detailed analysis, although his interpretation in general and in many specific points anticipates mine.

<sup>285</sup> Read γινόμενον with ἤρξατο and with ἐτελεύτησε. (So Simplicius.)

and an end (for it would at some time have been at the end of the process).

- b) But since it neither began nor stopped and always was and always will be, it has no beginning or end,
- c) For it is impossible for that to be always which is not everything.

That Being is not a process or the result of a process was previously proved;<sup>286</sup> but since only a process has beginning and end, Being can have neither (the conversion discussed above) and so is eternal (1 proved by a); next, as not being process, it has no point of initiation or completion (equivocation of ἀρχή and τελευτή) and so is spatially infinite (2 proved by b). Finally, the eternally existent must comprise within itself the sum of existence at any one time (a and b connected by c).<sup>287</sup> The argument of Melissus is a result of his general thesis that Being is not a process.<sup>288</sup> For him the initiation of a process is a point both spatial and temporal, at which time and from which position the genesis or alteration begins, and for every process there would be a moment and point at which the genesis or alteration, being completed, would cease to be what it was. Time and space are, then, two complementary dimensions in which all process occurs, from both of which Being as state is divorced, since true Being must be always and everywhere.

Aristotle understood that the ἀρχή of which Melissus spoke was an ἀρχή γενέσεως and, as such, not obnoxious to the charge of a gross confusion of time and space, as is clear from his further objection<sup>289</sup> that it is absurd to understand the ἀρχή not merely of absolute genesis but also of alteration, "as if

<sup>286</sup> Simplicius, *Phys.*, p. 103, 15-23.

<sup>287</sup> The interpretation of the last sentence, I think, is assured by *fragment* III: ἀλλ' ὥσπερ ἔστιν ἀεί, οὕτω καὶ τὸ μέγεθος ἀπειρον χρὴ εἶναι.

<sup>288</sup> Aristotle recognizes that this is the basic doctrine of the Eleatics. Cf. *Physics* 191 A 30: οὔτε γὰρ τὸ δὲ γίνεσθαι (εἶναι γὰρ ἤδη) . . . which does not mean, as some have interpreted it, "Being cannot be engendered" but "Being is not a process (i. e. in the process of coming to be), for it already is (i. e. is in a state of complete existence)."

<sup>289</sup> *Physics* 186 A 14-16.

there were no instantaneous alteration." The refutation practically admits the cogency of Melissus' argument in so far as it applies to what Aristotle would call "absolute generation";<sup>290</sup> and the only objection which is raised, resting as it does on Aristotle's doctrine of the possibility of instantaneous alteration,<sup>291</sup> shows that the connection of spatial and temporal initiation in the argument of Melissus was not due to his inability to discriminate between different meanings of an ambiguous term. The validity of the objection itself depends not only upon the curious physical theory, which allows to alteration no point of initiation within the subject and so denies that alteration is process, but also upon Aristotle's own distinction between genesis and alteration which, in turn, can be justified only by assuming the theory which makes primary matter pure potentiality informed by the pairs of opposites.

Since a unified part of natural existence can move in itself, Aristotle thinks that even if all Being is a unity still its immobility cannot be deduced from that fact. Here again Aristotle tries to confute Melissus by pointing to a physical phenomenon, the reality of which the Eleatics would deny, as evidence of the mobility of true existence. From Simplicius onward<sup>292</sup> there have been students who sought to defend Melissus against this criticism by insisting that the unified Reality of which he wrote was incorporeal and so not determined by time or space. But whether corporeal or not, true Being for him was clearly not phenomenal and no phenomenon could really *exist*.<sup>293</sup> Since phenomena constitute processes and true Being is not process but state, spatial motion as a necessary element of process cannot be predicated of Being. The clear statement that "if it were in motion, it would not exist"<sup>294</sup> makes it impossible to appeal to the phenomenon of physical motion against the thesis of Melissus and at the same time emphasizes the fact that for him only permanent and unlimited characteristics could attach to that which exists in any real sense.

<sup>290</sup> Cf. Simplicius, *Phys.*, p. 106, 17 ff.; Natorp, *op. cit.*, pp. 149-150.

<sup>291</sup> Cf. *Physics* 253 B 23-26.

<sup>292</sup> E. g. Simplicius, *Phys.*, p. 113, 10-18; Natorp, *op. cit.*, p. 151.

<sup>293</sup> Cf. *frag.* VIII, § 5.

<sup>294</sup> *Frag.* X.



Moreover, since Aristotle himself implies that the admission of spatial motion would immediately make room for alteration, he should have granted as much insight to Melissus. He would then have had to treat in a different manner the connection established between spatial and temporal initiation.

The possibility that by the Unity of Being Melissus may have meant specific unity Aristotle considers under two aspects. The obvious sense of such a statement he refutes by appeal to the physical world once more: clearly a horse and a man are specifically different. But, if such a statement means that the primary material source of all existing things is specifically one, then this is the doctrine of various physical philosophers too. Since Melissus rejected the possibility of alteration or difference of Being, he could not have endured the application of the terms "real" and "one" to either the matter or the result of alteration or genesis; and it is mere intransigence to insist upon enumerating phenomenal manifestations which are incompatible with a doctrine that denies the reality of phenomena. But the conclusion of the criticism of Melissus shows how Aristotle seeks to reinterpret the doctrine so as to make it a "stammering" attempt to express the basis of his own physics, for by the doctrine of potential matter he thinks he has expressed the kernel of truth in the Eleatic theory of reality.<sup>295</sup>

At the beginning of the specific criticism of Parmenides<sup>296</sup> Aristotle says that the same type of argument is valid against him, a statement which confutes the notion that Aristotle supposed the "Being" of Parmenides and Melissus to have been differently conceived.<sup>297</sup> Parmenides falsely assumed that "Being" is an absolute concept whereas it really is ambiguous; he then argued falsely because he did not see that even an

<sup>295</sup> Natorp, *op. cit.*, p. 16, note 3, correctly remarks that the entire critique of the Eleatics here is meant merely to introduce Aristotle's "Universalmittel," ὅλη = δυνάμει δν.

<sup>296</sup> *Physics* 186 A 22-B 35.

<sup>297</sup> Ross in his commentary on the *Metaphysics*, 986 B 19, Vol. I, p. 153, supposes that Aristotle made a distinction with regard to the subject-matter and treatment of Parmenides and Melissus (cf. page 67, note 273 *supra*); such a distinction, however, occurs only in the *Metaphysics* and for a particular purpose (cf. page 220, note 15 *infra*).

inseparable predicate is essentially different from the subject of which it is predicated. This explanation of the error of Parmenides is equivalent to the logical critique of Plato's *Sophist*; but here the language of Aristotle's correction is accommodated to his own physical terminology, and the way is prepared for a transition from the theory of predication, which is the result of the Eleatic criticism in the *Sophist*, to the doctrine of substrate and inhering accident. Aristotle implies that ignorance of the logic of predication led Parmenides to a mistaken notion of the physical world. The concept of Being as held by Parmenides is then subjected to a criticism which, by the process of showing that it will not fit into a logical proposition, is intended to prove that it cannot represent anything. If this Parmenidean Being is substantial Being and substantial Unity, it cannot be predicated of any subject since such a subject would be non-existent if "Being" were not an equivocal term; but neither can it act as subject, for, if anything else were predicated of it, the predicated attribute would have to be non-Being and non-Being would then be predicated of Being. Aristotle tacitly assumes that Parmenides would have to think of Being as an element in a proposition; he fails to consider the possibility that Parmenides may have fallen into error just because, having envisaged the concept of transcendental Being, he denied the possibility of existence on any lower scale. Aristotle, in trying to press the Parmenidean "Being" into service in the physical world and in rejecting its possibility because it cannot fulfil such service, is guilty of the same kind of error as Parmenides was, for he too assumes that the concept of Being must be fitted to one scale only. But his conclusion is the contrary of that of Parmenides in that he holds to the exclusive reality of phenomenal Being which Parmenides completely rejected.<sup>298</sup>

<sup>298</sup> It is not necessary to assume that Parmenides had clearly conceived transcendental Being in itself; Aristotle himself had an inkling that Parmenides was trying to get at something essentially different from phenomenal existence (cf. page 66, note 270 *supra*), and Plato's frequently expressed respect for the Eleatic doctrine seems to be due to his feeling that it really aimed at the static certainty of the super-phenomenal world (e. g. *Theaetetus* 183 E 3 ff.). It is enough, for the moment, to understand that the Eleatics were stressing the immutable reality



When Aristotle proceeds to the objection that substantial Being cannot have magnitude because as magnitude it would have parts which must then be essentially different from one another, he is using an argument resting finally on his doctrine of categories and considering the Eleatic Being as a spatial continuum equivalent to the substantial infinity which he attributes to the Pythagoreans and against which he uses the same argument.<sup>299</sup> The same doctrine derived from the categories forms the transition from the refutation of the possibility of the Eleatic Being as spatially continuous unity to that of its interpretation as essential and indivisible unity. Being, as substantial, must consist of parts which are themselves substantial, as is proved by the definition of such a thing.<sup>300</sup> That the elements of the definition cannot be accidental attributes rests upon the axiom that substance itself cannot be an attribute of any subject; and this axiom depends finally upon the exclusive character of the categories. The implication for the Eleatics is that, whatever is meant by their *Being*, it must, as a substantial existence, be defined by other substances which fact destroys its presumed unity.<sup>301</sup> But here again Being for Aris-

which is manifested in thought and the objects of thought as opposed to the instability of physical phenomena, and that, in the manner of those who make a startling discovery, they reserved to the new concept the sole right to consideration. But it is not impossible that they should still have considered this transcendental Being as somehow physical, though they certainly held it to be different from anything perceptible.

<sup>299</sup> See pages 24-25 *supra*.

<sup>300</sup> Aristotle's own solution is that no universal term has substantial existence, cf. *Metaphysics* 1041 A 3-5. But the argument only proves that the Eleatic Being is indefinable and transcendent; not that there is no transcendent Being. The Eleatics might well have used Aristotle's own admission that Being "runs through all the categories" (*Metaphysics* Γ, chap. 2) to prove that merely because the concept will not fit into any one of the categories one cannot argue that it does not exist or that it is meaningless.

<sup>301</sup> The origin of Aristotle's criticism is clearly Plato, *Sophist* 245 B-D; but the presumption of the doctrine of categories has restricted the application of the critique to physical existence. It is strange that Aristotle failed to see the similarity of the Eleatic Being and his own God in respect of the problems of existence. Reflection upon this similarity should have made it apparent that any attempt to apply the categories to Eleatic Being must miss the fundamental motive of the conception.

totle is conceivable only as phenomenal, for substance and propositional subject are treated as equivalent and exhaustive.

The Eleatic argument<sup>302</sup> seemed cogent to some people who felt constrained thereby to admit the necessity for the existence of non-Being and to posit atomic magnitudes.<sup>303</sup> But, Aristotle says, even if *Being* is unequivocal, nothing prevents non-Being from existing, not as absolute non-Being but as "not being a particular thing." For Being in and for itself is simply substantial Being which may be manifold.

There is throughout this critique an apparent confusion of logical and physical concepts which is due to the dependence of Aristotle's physics upon his logic. At one time he said that the Eleatic error was due to the ignorance of the meaning of relative or *accidental* non-Being,<sup>304</sup> that is of logical privation which is the essence of the negative proposition; but such a concept, which in its Platonic origin was simply logical, is at once transformed into a physical doctrine by Aristotle, so that

<sup>302</sup> *Physics* 187 A 1-10.

<sup>303</sup> The Greek commentators, Simplicius, Themistius, Philoponus, Alexander, understood the sentence to refer to Plato and Xenocrates, the first of whom is then charged with positing non-Being in answer to Parmenides, the second with setting up indivisible lines. Further, the two Eleatic arguments are divided, the first being given to Parmenides, the second (by Simplicius, Themistius, Philoponus) being identified with Zeno's first paradox. But since Plato posits absolute non-Being no more than does Aristotle (cf. Plato, *Sophist* 258 A 11-B 3; D 7-E 3; E 6 ff.), since Aristotle does not use *ἄτομα μεγέθη* specifically for Xenocrates' *ἄτομοι γραμμαί*, and since he represents the two Eleatic arguments as the incentives to the Atomic theory of Leucippus (cf. *De Generatione* 325 A 2 ff., especially 26-29), it seems certain that the *ἐνιοί* of the present passage are the Atomists. (For the other view see Robin, *La Théorie Platonicienne des Idées et des Nombres*, note 272, IV, pp. 300 ff.)

The second Eleatic argument here mentioned, the *dichotomy*, was referred by Porphyry to Parmenides; since the simple term is used by Aristotle of Zeno's first paradox (*Physics* 239 B 22), it is most likely to refer to the same argument here, although it has not previously been mentioned in this passage.

In *Metaphysics* 1089 A 2-6 Aristotle refers to some who made the "indeterminate dyad" an element in the generation of things, influenced by the argument of Parmenides to prove that non-Being exists. Ross suggests that he has in mind such passages as *Sophist* 237 A, 256 E, 241 D. In that case he overlooks the limitations *ἡ θατέρου φύσις, κατὰ τι, πῃ* in these passages which make the sense equivalent to his own *ὅν τι εἶναι τὸ μὴ ὅν*.

<sup>304</sup> *Physics* 191 B 13-16.



he can say shortly thereafter that an understanding of the nature of substrate would have solved the difficulties of the Eleatics.<sup>305</sup> Privation is, in effect, the immediate material of generation<sup>306</sup> and the logical subject of privation is transmuted by means of the concomitant potentiality into the physical substrate.<sup>307</sup> The notion that privation of a quality requires in the substrate the potential presence of that quality is a rule of logic<sup>308</sup> transferred to descriptive physics. It is this connection of the matter of generation and of thought, this equivalence of the proposition of logic and the description of physical change which makes Aristotle think the *Physics* an appropriate place to discuss the Eleatic doctrine which on his own reckoning falls outside the sphere of physics.

As the Eleatic doctrine is supposed to have led to difficulties of physical theory which could be solved by a correction of Eleatic logic, the denial of the laws of contradiction and excluded middle is treated as a consequence of mistakes in physical theory. Many of the physical philosophers asserted, Aristotle says, that the same thing can be and not be and that things can be so conceived.<sup>309</sup> Subjective relativism and the denial of the law of contradiction are complementary; and one who accepts the doctrine of Protagoras that all opinions are true must admit that everything is at once true and false, while, if the same thing both is and is not, all opinions must be true.<sup>310</sup>

<sup>305</sup> *Physics* 191 B 33-34.

<sup>306</sup> *Physics* 191 B 15-16. Yet 191 B 35 ff. he reproaches the Platonists for making matter "non-Being" and claims himself to differentiate privation and matter.

<sup>307</sup> The transformation is carried so far that *στέφανος* becomes, instead of simple negation of form, a positive reality, a kind of form itself (*Physics* 193 B 19-20). Cf. Baeumker, *Problem der Materie*, pp. 218-219.

<sup>308</sup> Cf. its use in *Topics* 148 A 3-9. It is a mistake to define a thing by privation of that which is not potentially predicable of it. The logical basis of the physical doctrine, as well as some of the difficulties involved in the development, is to be seen in *Metaphysics* 1055 A 33-B 29.

<sup>309</sup> *Metaphysics* 1005 B 35-1006 A 2.

<sup>310</sup> *Metaphysics* 1009 A 6-16. Cf. the conclusions drawn by Plato from Protagoras' doctrine that all opinions and sensations are true, *Theaetetus* 161 C-162 A, 170 E-171 C.

The Protagoreans<sup>311</sup> are further forced to admit that everything is one and the same, since they assert that contradictories may truthfully be predicated of the same thing at the same time; this, Aristotle says, amounts to the same thing as the statement of Anaxagoras that all things are together;<sup>312</sup> consequently nothing really exists. The Being, then, of which they speak is rather non-Being, for it is the indeterminate which exists only potentially. In other words, the Protagoreans and Anaxagoras, too,—for consistently he should have developed from his physics the same logic as the subjective relativists—have been misled because they failed to understand the nature of the material substrate. The matter of all things is certainly one, but one as pure potentiality and many and different in actuality.<sup>313</sup> That they must affirm and deny everything of each thing is a consequence of affirming contradictories of the same thing, for if A is non-A it is *a fortiori* non-B and so B. This denial of the law of contradiction brings in its train, however, the denial of that of the excluded middle,<sup>314</sup> for "neither A nor non-A" is itself the contradictory of "both A and non-A," whether each be treated as a single proposition or both as two.

The thesis of Protagoras that man is the measure of everything means simply that anything which to anyone seems to be really is; this requires him to believe that the same thing is and is not, that is, to assume that reality is determined by indi-

<sup>311</sup> *Metaphysics* 1007 B 18-1008 A 2. The case is put in a different manner in *Post. Analytics* 89 A 25-28: The thesis that there may be various opinions of the same object which are true (to some subjects) and at the same time false (to other subjects) results in the doctrine that false opinion is impossible. The result, which becomes the corner-stone of all subjectivism, is the belief that there is no objective truth.

<sup>312</sup> The phrase is taken from Plato, *Phaedo* 72 C. But, whereas Plato means that, unless there were reciprocity of generation and destruction, the world would be reduced at some time to a state equivalent to that described by Anaxagoras before the entrance of *νοῦς*, Aristotle refers the phrase to the description of individual objects and supposes that the physics of Anaxagoras implies the logic of the Protagoreans. Cf. *Metaphysics* 1009 A 25 ff.

<sup>313</sup> Aristotle tries to reinterpret the "mixture" of Anaxagoras as his own prime matter elsewhere. Cf. *Metaphysics* 1069 B 18-24, page 57 *supra*.

<sup>314</sup> *Metaphysics* 1008 A 2-7.

vidual opinion.<sup>315</sup> The original source of this theory is represented as twofold. In the first place, the universal opinion of the physicists that nothing comes to be from nothing, in conjunction with the obvious truth that a thing cannot become what it already is, required the hypothesis that a given characteristic must have been at the same time present and not present in the original substrate.<sup>316</sup> As contraries are seen to arise from the same substrate, the conclusion was that the same object must originally have been both contraries, a conclusion expressed by Anaxagoras as the mixture of everything in everything and by Democritus in his theory that the full and the void, that is Being and non-Being, exist in every part of everything.<sup>317</sup> The denial of the law of contradiction in this case is due to a misunderstanding of the concept of non-Being in generation;<sup>318</sup> and the logical difficulty disappears when one understands that a thing may exist in two senses, potentially and actually, and that consequently a thing may be both contraries at once potentially but not actually. Further, Aristotle thinks it possible to obtain from these adversaries the admission of an unchangeable substance.<sup>319</sup> The theories which Aristotle here criticizes are physical theories meant to explain physical change; the alternative which he suggests is a logical analysis which merely states again the problem Anaxagoras and Democritus tried to solve; but it is crucial that Aristotle thought his analysis was itself a physical theory. Neither Atomism nor the Anaxa-

<sup>315</sup> *Metaphysics* 1062 B 12-19. Cf. *Metaphysics* 1053 A 35-B 3 where Protagoras is said to mean only the common notion that perception and knowledge are the measures of the objects to which they are applied. Aristotle, however, claims that they measure only by being measured against the objective reality. So in *Nicomachean Ethics* 1113 A 15-B 2 Aristotle holds that there is an objective good which is the real object of βούλησις, even though the object of individual acts of purposeful willing be the apparent good. But this apparent good is not the good for him to whom it appears to be; each man's will is measured by the objective good; consequently only the σπουδαῖος is the measure in the sense of determining the good, and that simply because he correctly discerns the objective truth.

<sup>316</sup> *Metaphysics* 1062 B 24-30.

<sup>317</sup> *Metaphysics* 1009 A 22-30. Cf. pages 51 f. *supra* for the statement that Anaxagoras built his theory on the axiom that nothing comes from nothing.

<sup>318</sup> *Metaphysics* 1062 B 30-33.

<sup>319</sup> *Metaphysics* 1009 A 30-38.

gorean doctrine of mixture as such denies the law of contradiction; if some sophistic or eristic thinkers used these physical theories as a foundation for logical nihilism, Aristotle should have demonstrated that the error lay in this misunderstanding instead of trying to show that the physics was false because the logical consequences mistakenly drawn from it were untenable. But, since he has maintained that these physical doctrines are wrong because they cannot account for alteration and genesis in his sense, and since this failure is due to their lack of a substrate which is potentially a pair of opposites,<sup>320</sup> the mechanism by which alone he held it possible to account for the problem of identity and difference, he held that such physical theories must imply a denial of the law of contradiction. Yet such an implication would depend upon the introduction of the category of substance considered as logical (or grammatical) subject, a notion foreign to all the Presocratics. Aristotle sought to discover in these preceding physical doctrines, however, an analogy to his own prime substrate;<sup>321</sup> and, once persuaded that he had succeeded in so doing, he could accuse them all of logical inconsequence, and that on the basis of a misunderstanding of the purely potential character of the substrate.

The second source of this error is the variety of sensations concerning a single object<sup>322</sup> and the lack of any norm by means of which one sensation may be accorded a higher grade of reality than another.<sup>323</sup> Democritus, Empedocles, Parmenides, Anaxagoras, and "almost every philosopher" have fallen into this impasse for the general reason that they identified knowledge and sensation and made sensation an alteration with the result that every sense-appearance must be true.<sup>324</sup> This led Democritus to say that nothing is true or that what is true is not evident to us.<sup>325</sup> And Anaxagoras said to some friends that things would be for them even so as they under-

<sup>320</sup> Cf. pages 57 ff. *supra*.

<sup>321</sup> Cf. pages 53 ff. *supra*.

<sup>322</sup> *Metaphysics* 1062 B 22-24.

<sup>323</sup> *Metaphysics* 1009 B 1-11. Cf. Plato, *Theaetetus* 158 B-E.

<sup>324</sup> *Metaphysics* 1009 B 11-33.

<sup>325</sup> *Metaphysics* 1009 B 11-12.



stood them to be.<sup>326</sup> To prove that Empedocles made knowledge a function of the bodily constitution<sup>327</sup> two passages are quoted, "The understanding grows for men according to what is present";<sup>328</sup> and "The thinking of men changes character in proportion as they themselves alter."<sup>329</sup> The same doctrine is attributed to Parmenides on the basis of his statement, "Thought comes to men in accordance with the composition of their bodies, since for each and every man what thinks is the same, the bodily composition. For thought is that which preponderates (in the body)."<sup>330</sup> These thinkers seek to attribute the same theory to Homer by interpreting his epithet ἀλλοφρονέων of the swooning Hector to mean that even those who are "out of their minds" have thoughts, only not the same thoughts.<sup>331</sup> The conclusion from such a doctrine, Aristotle says, is necessarily the assumption that things are at the same time so and not so. This statement is developed elsewhere<sup>332</sup> with the addition that these theorists held that

<sup>326</sup> *Metaphysics* 1009 B 25-28.

<sup>327</sup> *Metaphysics* 1009 B 17-21.

<sup>328</sup> *Fragment* 106. Πρὸς παρὲν Ross in his commentary translates "the object present to sense," in his translation (following Diels) "according to their present state." From the introductory words of Aristotle and from the fact that he adds the next quotation as an equivalent statement it seems clear that Aristotle understood the phrase in the second sense. The same passages are quoted in *De Anima* 427 A 21-29; there the final object is the deduction that the ancients identified thought and perception, but this conclusion is reached by proving from these passages that Empedocles conceived thought to be corporeal which amounts to reducing it to perception.

<sup>329</sup> *Fragment* 108.

<sup>330</sup> *Fragment* 16. Since Aristotle draws from the fragment the conclusion that Parmenides agreed with Empedocles in making thought corporeal, he must have taken ὅπερ as subject of φρονέει. H. Fränkel is probably right, however, in construing it as the object. (Cf. "Parmenidesstudien" von Hermann Fränkel, *Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen, Philol.-Hist. Klasse*, 1930, pages 172 ff.)

<sup>331</sup> In *De Anima* 404 A 27-30 this interpretation is attributed to Democritus who used it to support his theory that sense-perception is the truth. Aristotle himself attributes the same doctrine to Homer by means of a violent interpretation of *Odyssey*, XVIII, 136-7 (*De Anima* 427 A 25-6). Cf. pages 292, note 9 and 313, note 86 *infra*.

<sup>332</sup> *De Anima* 427 A 26-B 5.

thought and perception are the result of an alteration of like by like, from which it follows that all sensations are true and error is impossible. It is obvious that since all four of the philosophers charged with sensationalism claimed as finally true certain principles which deny the truth of ordinary sense perception, none of them could correctly be called a sensationalist. The evidence on which Parmenides is here included is a passage from the second part of his poem, the account of opinion; the story told of Anaxagoras is of a moralistic nature and offers no ground for denying his rationalism.<sup>333</sup> Aristotle has mistaken Parmenides as usual; Anaxagoras probably made no exact pronouncements concerning knowledge; and Aristotle felt justified in including him in this group by reason of his physical doctrine, although his strict separation of νοῦς should have assured him better treatment.<sup>334</sup> Empedocles, too, put no great trust in the senses, although he evidently felt the intelligence also was too weak to comprehend the final truth without divine inspiration.<sup>335</sup> Certainly he made no clear distinction between thought and sensation, and he did make the latter depend upon the bodily constitution; but this is not quite the same as conscious identification of perception and intelligence, and Empedocles did not see in this theory any reason for believing that all perceptions are true, although Aristotle is right in saying that it is not clear how he could on his assumptions account for error. Democritus, however, is specifically charged with maintaining the truth of perception and the identity of soul and mind.<sup>336</sup> Yet he is known to have said that only the atoms and void truly exist while the sensible qualities

<sup>333</sup> Cf. Anaxagoras' condemnation of the testimony of sense, *frag.* 21 (Sextus, *adv. math.*, VII, 90).

<sup>334</sup> It is possible that some such remark of Anaxagoras as the reported ὅψις τῶν ἀδῆλων τὰ φαινόμενα (*fragment* 21 a, Sextus, *adv. math.*, VII, 140) in conjunction with his failure to explain how the soul, being without communion in other things, can have any knowledge (*De Anima* 405 B 19-23) may have led Aristotle to the decision that Anaxagoras identified knowledge and perception.

<sup>335</sup> *Fragment* 2 (Sextus, *adv. math.*, VII, 122-124); the interpretation of Sextus is much too exact and schematic to represent the true meaning of Empedocles. Cf. Zeller-Nestle, *op. cit.*, I, 998-1000.

<sup>336</sup> *De Anima* 404 A 27-31.

and characteristics are only conventional and apparent; true knowledge he divorced from the bastard knowledge of the senses.<sup>337</sup> When he says that man is far from the truth,<sup>338</sup> he means that the application of the distinction of the so-called primary and secondary qualities shows that the usual opinions of men are false. What we know by sense perception is unstable, for it is the result of a conjunction of the shifting state of the body and the streaming effluences which are constantly changing.<sup>339</sup> Some sort of distinction between intelligence and sensation Democritus must have made, since he held his own atomism to be true and could not appeal to sense as a witness. But unfortunately he admitted that in the end intelligence waits upon the senses to furnish it material for thought; Democritus clearly saw the difficulty which arose from the necessity of arraigning the truth of the senses on evidence gained from the senses themselves.<sup>340</sup> The only way out is, after all, to grant a certain degree or aspect of truth to all sensation; this seems to be the procedure referred to by Aristotle elsewhere.<sup>341</sup> Because the Atomists considered truth to be involved in sensation, he says, and since there are infinite and contrary perceptions, they set up an infinite number of atoms so that the same thing by the slightest change of its constituent atoms might appear different to different people. So the objective truth of all sensation is saved in the sense that every sensation represents a physical condition, the result of the conjunction of the atoms of the effluence with the atoms of the perceiving subject. But contradictory perceptions of a single object do not prove that the object has contradictory characteristics; rather are such perceptions the material whence true knowledge may deduce the objective truth of atoms and void. Aristotle's statement that

<sup>337</sup> *Fragments* 9 and 11.

<sup>338</sup> *Fragment* 6; cf. Dyroff, *Demokritstudien*, p. 98, note 3.

<sup>339</sup> *Fragment* 9 (Sextus, *adv. math.*, VII, 135-136).

<sup>340</sup> Because the material for reaching the truth is afforded genuine thought by the senses, he praised Anaxagoras for the axiom  $\delta\psi\iota\varsigma\ \gamma\acute{\alpha}\rho\ \tau\acute{\omega}\nu\ \acute{\alpha}\delta\eta\lambda\omega\nu\ \tau\acute{\alpha}\ \phi\alpha\iota\nu\acute{o}\mu\epsilon\nu\alpha$  (Sextus, *adv. math.*, VII, 140); but, since this is the case, the senses have a cogent defense against this "true knowledge":  $\tau\acute{\alpha}\lambda\alpha\iota\nu\alpha\ \phi\rho\eta\nu,\ \dots\ \pi\tau\acute{\omega}\mu\acute{\alpha}\tau\omicron\iota\ \tau\acute{o}\ \kappa\alpha\tau\acute{\alpha}\beta\lambda\eta\mu\alpha$  (*Fragment* 125).

<sup>341</sup> *De Generatione* 315 B 9-15.

the Atomists considered truth to be *involved in* perception seems to represent more correctly the attitude of Democritus; what appears in sensation is true only in the sense that there is real objective cause for all sensations, the full truth is hidden from us only in being hidden to perception as atoms and void.<sup>342</sup> For such a doctrine it is crucial, however, that intelligence be clearly distinguished from perception and firmly established in its own right; otherwise the result is relativism of the kind Protagoras set up.<sup>343</sup> Democritus<sup>344</sup> is not guilty of identifying knowledge and perception; but his attempt to distinguish them fails because his strict and consistent materialism leaves him nothing of which to construct the independent critical faculty which he wants to place in judgment over sensation.

Aristotle, himself, attributes this result to the fact that all these philosophers while searching for the objective truth assumed that only sensible things had real existence.<sup>345</sup> Consequently they saw that the object of their research was completely involved in motion and they were aware that no true statement could be made about what was always and in every respect shifting.<sup>346</sup> It was matter with which they tried to deal, but they failed to appreciate the nature of the material, for they did not understand the indeterminate element, that is the potentiality, of the substrate. Here, then, Aristotle makes the second source of the error—the problem of the variety of perception—an outgrowth of the first, the ignorance of the nature of his primary matter. So their solutions of the problem were bound to be false,<sup>347</sup> whatever plausibility might be lent to them by perceptible appearance. The final development of this

<sup>342</sup> Cf. Dyroff, *op. cit.*, pages 96-97.

<sup>343</sup> Sextus, *Pyrrhon. Hypotypos.*, I, 217-219. The physical foundation for Protagoras' relativism resembles both Atomism and the Anaxagorean mixture. Since everything is in all parts of matter, the variation of sensation depends upon the varying constitution of the subject.

<sup>344</sup> Cf. page 292, note 10 *infra*.

<sup>345</sup> *Metaphysics* 1010 A 1-9.

<sup>346</sup> Cf. Plato, *Theaetetus* 152 D-E, 157 B.

<sup>347</sup> The "correction" of the criticism passed upon Xenophanes by Epicharmus is obscured by the impossibility of reconstructing the words of the latter. Cf. Ross, *Commentary on the Metaphysics*, vol. I, p. 276.



attitude was the doctrine of the so-called "Heraclitizers" represented by the extreme attitude of Cratylus, who thought one ought not say anything and so only made signs with his finger.<sup>348</sup> He corrected the remark of Heraclitus<sup>349</sup> that one cannot step into the same river twice, thinking it could not be done even once.

Aristotle confesses that it is impossible to meet the demands of a consistent relativist of this kind who will not admit that there is no demonstration of that which is the starting-point of demonstration;<sup>350</sup> but he gathers together all the difficulties which must embarrass such an opponent. Against the Heraclitean thesis he uses the *περιτροπή*; <sup>351</sup> there is a real distinction between appearance and sensation as the actions of the relativists themselves prove against their own words; <sup>352</sup> and, since each sense is a better judge of its proper object than the other senses are, it is clear that there is a necessary permanence of character for each quality so that there is stability even in sense

<sup>348</sup> Cf. *Rhetoric* 1417 B 1 ff. According to Plato (*Cratylus* 429 D), Cratylus argued that it is impossible to say anything false, because whatever one says is *ipso facto* τὸ ὄν. This argument rests upon the Eleatic axiom that it is impossible to conceive of τὸ μὴ ὄν, cf. Plato, *Sophist* 260 D-E. It has the opposite conclusion to the way of thought attributed to him here.

<sup>349</sup> The statement of Heraclitus is quoted by Plato (*Cratylus* 402 A). In *Metaphysics* 1005 B 23-26 Aristotle says that some people deny the law of contradiction on the presumed authority of Heraclitus. He implies that Heraclitus seems to say that it is possible to conceive the same thing to be and not to be; but Heraclitus, he claims, need not be supposed to have held the opinion which his words imply. So in *Metaphysics* 1062 A 31-35 he says that, if one could discuss the matter with Heraclitus, one could probably get him to admit that contradictories cannot be true of the same subject; Heraclitus did not understand the implications of his opinions. Elsewhere, however, Heraclitus is treated as though he must necessarily and consciously have rejected the law of contradiction.

<sup>350</sup> *Metaphysics* 1011 A 3-16 (cf. the doublet, *Metaphysics* 1063 B 7-15). The comparison of such an attitude to that which asks for a *proof* to distinguish waking perceptions from sleeping phantasies refers to Plato, *Theaetetus* 158 B-D. The relativist has no criterion by means of which he can rank one sensation higher than another.

<sup>351</sup> *Metaphysics* 1062 A 36-B 11. Cf. Plato, *Theaetetus* 171 B-C.

<sup>352</sup> *Metaphysics* 1010 B 1-14, 1062 B 33-1063 A 10, 1008 B 12-27. Cf. Plato, *Theaetetus* 171 E, 178 A ff.

perception, whereas necessity is excluded by all these views which exclude essence.<sup>353</sup> Aristotle is concerned to prove that there is permanence not only in the self-identity of the formal cause<sup>354</sup> but even in the major part of the sensible world: the nature of the heavenly bodies is not subject to alteration and so manifestly refutes the physical basis of the relativistic thesis.<sup>355</sup> But even if everything is in motion, motion and alteration require limits, so that a persistent subject is presumed by process and it is impossible to suppose such a subject to be at both limits at the same time.<sup>356</sup> This thesis that all attributes may be predicated of every subject at once is incompatible with the concept of motion and rather requires the conclusion that all things are at rest in their common identity.<sup>357</sup>

This refutation presupposes that the opponents of Aristotle admitted the existence of an objective world which is at least partially responsible for the character of the various sensations. At the same time, Aristotle feels, they mean that, as all the sensations are equally true, only the sensations really exist;<sup>358</sup> and he argues that, since perception is not its own object and since the movent is naturally prior to the moved, the substrate which is the object of perception must exist independently of it.<sup>359</sup> Those who say that every appearance is true must make *everything* relative. If only one term of the relation

<sup>353</sup> *Metaphysics* 1010 B 14-30, 1063 A 28-35. Cf. Plato, *Theaetetus* 182 D-183 B, 186 B.

<sup>354</sup> *Metaphysics* 1010 A 22-25, 1063 A 22-28.

<sup>355</sup> *Metaphysics* 1010 A 25-32, 1063 A 11-17.

<sup>356</sup> *Metaphysics* 1010 A 15-22, 1063 A 17-21.

<sup>357</sup> *Metaphysics* 1010 A 35-37.

<sup>358</sup> *Metaphysics* 1010 B 30.

<sup>359</sup> *Metaphysics* 1010 B 30-1011 A 2. At 1047 A 4-7 the Megarian doctrine that only the actual is possible leads to the thesis, he says, that perceptible qualities exist only while being perceived and consequently the Megarians will have to maintain the position of Protagoras. If we can believe Sextus (*Pyrrhon. Hypotyp.*, I, 218), however, Protagoras admitted a material substrate which contains within itself all possible perceptible characteristics. Different percipients, however, in consequence of their own varying constitutions and states, apprehend different characteristics. He posited, then, a common object of sensation which appears different to different subjects or to the same subject at different times because it is apprehended only partially by any one percipient at any one moment.

"percipient-perceptible" is in flux, there will be a standard of reference and the paradox will be dissolved;<sup>360</sup> but, if everything is relative and relative to thought and perception, the essence of each and every thing will be exhausted by this characteristic, nothing can have been or be about to be except as having been previously perceived or thought. As relative to the thinking subject a man can be only the object of thought, while the thinking subject, being relative to an infinity of specifically different objects, will itself be indefinable.<sup>361</sup>

Aristotle had previously said that the denial of the law of contradiction entailed also a denial of that of the excluded middle<sup>362</sup> and that the Protagorean thesis amounted to the physical doctrine of Anaxagoras. Starting from the physical doctrine, however, he claims that the statement of Heraclitus, according to which all things are and are not, seems to make everything true, while the notion of Anaxagoras that there is an intermediate between contradictories makes everything false, for his "mixture" is neither good nor not good and consequently one cannot assert anything true.<sup>363</sup> But the two atti-

<sup>360</sup> *Metaphysics* 1063 A 35-B 7. Cf. Plato, *Theaetetus* 159 D-160 C.

<sup>361</sup> *Metaphysics* 1011 A 17-B 12.

<sup>362</sup> Page 77, note 314 *supra*.

<sup>363</sup> *Metaphysics* 1012 A 23-28. In *Topics* 159 B 30-35 it is said that, if one intends to defend the statement of Heraclitus that "good and bad are the same thing," one must admit that contraries may be predicated of the same thing because this must have been the intention of Heraclitus. This throws some light on Aristotle's procedure in the *Metaphysics*. *Physics* 185 B 19-25 refers to the same dictum of Heraclitus. Here, according to Ross, Aristotle is rather thinking of the physical doctrine of flux. Yet at *Metaphysics* 1012 B 26-27 he says that if everything is in motion, *nothing* is true; and in 1010 A 8 ff. (to which Ross refers in support of his interpretation) it is clear that Cratylus refrained from speaking because his doctrine of flux made him believe that *no* statement could be true. (Cf. Heraclitus, *fragment* 91 [Diels].) Here, then, Aristotle must be thinking rather of the tendency of Heraclitus to identify all things as one (really as different aspects of the one world-process). Cf. *fragments* 8, 10, 50, 51, 57, 62, 67, 88 (Diels).

The same distinction between Heraclitus and Anaxagoras is drawn in *Metaphysics* 1063 B 19-35: Anaxagoras, by saying that everything has a share of everything else, implies that nothing is more sweet than bitter, etc. Yet Anaxagoras said that no two things are alike but that each is characterized by its predominant ingredient (*fragment* 12, page 405, lines 13-15 [Diels]).

tudes, "everything is true" and "everything is false," are subsumed under the Heraclitean notion that everything is true and false, since the compound statement asserts the two elements separately also.<sup>364</sup>

The argument is closed with a deduction of the consequences for physics.<sup>365</sup> Since the same things are not always true or always false, it follows that not all things can be at rest;<sup>366</sup> and, since not everything is false, everything cannot be in motion.<sup>367</sup> Further Aristotle denies that everything can be now at rest and again in motion<sup>368</sup> on the ground that there must always be a prime mover of what is moved and the prime

<sup>364</sup> *Metaphysics* 1012 A 29-B 2. Aristotle meets the thesis here by an argument from the significance of the terms "true" and "false" and their mutual exclusiveness together with the significance of the definition (1012 B 5-13, 1008 B 3-12. For sources in Plato cf. Shorey, *What Plato Said*, page 593, note on *Sophist* 244 A). His final weapon is the *περιτροπή* (1012 B 13-22, 1063 B 30-35; cf. Plato, *Theaetetus* 171 A ff.).

<sup>365</sup> *Metaphysics* 1012 B 22-31.

<sup>366</sup> This is a new form of the objection to the Eleatic thesis. Since it denies physical change it must consistently deny that different attributes can be predicated of the same subject. The fallacy which led Parmenides to deny multiplicity and change, however, arose from his failure to see the essential difference of subject and predicate (*Physics* 186 A 23-32, cf. page 72 *supra*). It was the same ignorance which, according to Simplicius (*Phys.*, 120, 12 ff.), caused the Megarians to deny that two characteristics could be attached to the same subject.

<sup>367</sup> The Heraclitean doctrine of flux implies that no true statement can be made of anything. Cf. Heraclitus, *fragment* 91 (Diels). Cf. page 86, note 363 *supra*. In *Metaphysics* Γ, chapter 5 (especially 1010 A 1-15) the instability of the sensible world is said to have caused Anaxagoras, Democritus, Empedocles, and even Parmenides (!) to believe that nothing is true (cf. page 83 *supra*), and Heraclitus is mentioned only as having been reproved by Cratylus for not putting the statement forcibly enough. Implicitly in *Topics* 159 B 30-33, *Physics* 185 B 20-25, and explicitly in *Metaphysics* 1012 A 24-26 the doctrine of Heraclitus is said to mean that everything is true, though ten lines later (1012 A 34-36) Heraclitus is charged with saying that everything is both true and false and consequently both that all is true and that all is false. Aristotle feels justified, then, in drawing from Heraclitus' physics either conclusion as it suits his present purpose; but the historical development is more correctly reproduced in *Metaphysics* 987 A 32 ff. where the Heraclitean opinion held by Cratylus is reported to have been that the constant flux of all phenomena prevents the possibility of knowledge concerning them. Cf. also 1078 B 13-15 to the same effect.

<sup>368</sup> *Metaphysics* 1012 B 29-31. This is meant to dispatch Empedocles.



mover itself must be immobile. Thus he means to refute all the Presocratic physical doctrines by showing that they result in logical fallacies.<sup>369</sup> Just as the Eleatic difficulties are due to ignorance of the distinction of potential and actual being and disappear with an understanding of substrate and privation,<sup>370</sup> so all the other Presocratic doctrines were bound to transgress the law of contradiction because they missed the true nature of material substrate.<sup>371</sup> The permanence of the subject stressed by the Eleatics and the interchange of characteristics which the physicists maintained are reconciled by means of the theory which regards privation as potential inherence. This answer, which Aristotle considers a physical explanation, is really nothing other than the theory of predication as is shown by the fact that even in the physical works its validity is vindicated by comparison with the logical doctrine.<sup>372</sup> Since the logical fallacies of the Eleatics led to their mistaken physics,<sup>373</sup> Aristotle feels that he can apply directly to the physics the logical correction which is the theory of the proposition and achieve thereby an adequate physical theory.<sup>374</sup> On the other hand, since the logical fallacies of the physicists were the necessary result of their physical doctrines, the correction of the latter by his own physical hypothesis (which is a result of the criticism of Eleatic logic) will at the same time solve the former

<sup>369</sup> The passage is an imitation of Plato, *Sophist* 248 E-249 D where the possibility of intelligence is shown to require that both "rest" and "motion" must be recognized as being.

<sup>370</sup> *Physics* 191 B 10-34.

<sup>371</sup> See page 78, notes 316, 317, 318 *supra*; *Metaphysics* 1010 A 1-4, 1011 B 13-22.

<sup>372</sup> *De Generatione* 324 B 6-9: τὴν μὲν γὰρ ὕλην λέγομεν . . . τὴν αὐτὴν εἶναι τῶν ἀντικειμένων ὁποτέρου, ὥσπερ γένος ὅν. That the notion of physical substrate is simply the concept of the propositional subject transferred to the material world is clear from such passages as *Physics* 190 A 9-12, 190 B 17-23 where logical analysis is taken as equivalent to physical explanation. The "substance" of the categories (i. e. the subject of the proposition) becomes the material substrate which is then amenable to the same laws of development and implication.

<sup>373</sup> See pages 62-63 *supra*.

<sup>374</sup> See pages 75-76 *supra*. Cf. *Physics* 185 A 31-32.

difficulties.<sup>375</sup> The Platonic doctrine of the proposition in the *Sophist*, which is a result of the critique of Eleatic doctrine there, is the origin of this procedure of Aristotle. That he was conscious of converting the logical doctrine into a physical theory is clear from his criticism of Plato for not having developed the physical implications of substrate and privation in accordance with his own theory of predication.<sup>376</sup>

Alteration and motion, as well as genesis, proceed from contrary to contrary<sup>377</sup> and so are subject to the difficulties involved in the problem of contradiction; but that his conception of change does not transgress the law of the excluded middle Aristotle established by the observation that a given object, in its various parts, may be characterized by both terms of a pair of contraries simultaneously, while as a whole it is considered to have the character of the term which predominates in it.<sup>378</sup> This is no solution of the problem as it presents itself in any given moment of change; the real answer of Aristotle is found in his theory that in its ultimate terms alteration is instantane-

<sup>375</sup> See pages 78-79 *supra*.

<sup>376</sup> *Physics* 191 B 35-192 A 12. The influence of the Heraclitean flux, in its abolition of the possibility of knowledge, and of the Parmenidean Being, by its denial of multiplicity, on the development of the theory of ideas is recognized in *Metaphysics* 1078 B 9-17, 1089 A 2-6. Cf. 987 A 32-34.

<sup>377</sup> *Physics* 261 A 32-B 1, 226 B 1 ff., 188 B 21 ff., *De Generatione* 331 A 14, etc.

<sup>378</sup> *Physics* 240 A 19-29. This is appended to the refutation of Zeno's four paradoxes and is followed by an answer to the argument that rotating bodies are at rest; since the argument here refuted is not represented as an argument of Zeno (cf. 239 B 9-10 where only four arguments are attributed to him) and aims at refuting the possibility of alteration by a method derived from the paradox of Zeno, it is likely that it represents a proof of the Megarian school. (Cf. Eusebius, *Praep. Evang.*, XIV, 17 and the paraphrase of our passage by Simplicius [1020, 11 ff.] with the argument attributed to Diodorus by Sextus [Pyrrhon. *Hypotyp.*, III, 71; II, 242-3] and cf. the last with lines 26-29 of the present passage). If the paradox implied here was Megarian as *Soph. Elench.* 167 A 7-20 indicates, it appears that this school made use of the law of the excluded middle to confute the partisans of change; this suggests the possibility that Eubulides had made use of one of Aristotle's own axioms to refute his physical doctrine and that it is this argument of Eubulides which Aristotle is here answering.



neous,<sup>379</sup> for alteration and genesis occur in the "acquisition" by matter of forms which involve in their alternate existence and non-existence no temporal process.<sup>380</sup> Here again the terminology of privation and potential information, because it enables Aristotle to escape the logical dilemma with which the eristics could confront the Presocratics, appeared to him to be an adequate explanation of the physical processes. This logical analysis of the physical problem is galvanized by developing the implications in the mechanism of the relationship of activity and passivity.

The pluralists,<sup>381</sup> both those who treat the four simple bodies<sup>382</sup> as ultimate<sup>383</sup> and those who construct them of other constituents,<sup>384</sup> as well as the monists employ in their develop-

<sup>379</sup> See *Physics* 253 B 23-26; *De Sensu* 446 B 29-447 A 7; *Physics*, VI, 5.

<sup>380</sup> See *Metaphysics* 1033 B 5-19, 1039 B 20-27, 1044 B 21-28. This is the foundation of the attack upon Empedocles' statement that light requires time to move from point to point. In *De Anima* 418 B 20-26, besides the argument that light could not move swiftly enough to pass from the eastern to the western horizon without the motion's being detected by sight, such an hypothesis is said to be contrary to the analysis of light previously given. This analysis (*De Anima* 418 B 9-20) has revealed that light is the actuality of the transparent quâ transparent, the agency of which actualization is fire or the fifth essence. Light, then, is the "form" of the transparent, the acquisition of which is instantaneous. In *De Sensu* 446 A 27-447 A 11 the problem recurs in connection with the media of sensation, and Empedocles' statement about the motion of light is said to involve the doctrine that the object of sight takes time to pass through the medium to the eye. This is refuted by the statement that light is an actuality (446 B 30-447 A 7), not a movement. The transparent, however, is actualized under the agency of fire or the fifth essence, that is the transparent attains its form, which is light, as a result of alteration. Consequently Aristotle has to point out that alteration (which is a kind of motion—cf. 406 A 12-13) differs from spatial motion in being instantaneous. So the whole sky, quâ transparent, may become light (i. e. be brought to its actuality by the agency of the sun) all at once, though Aristotle adds—for very obvious reasons—that a large continuous body undergoing alteration need not as a *single unit* undergo instantaneous change.

<sup>381</sup> *De Generatione* 322 B 6-21.

<sup>382</sup> τὰ στοιχεῖα (referred to in 322 B 1 as τὰ καλούμενα στοιχεῖα) are here the conventional elements, earth, air, fire, and water, which for Aristotle are not really "elements" any more than they were for Plato or the Atomists.

<sup>383</sup> Empedocles.

<sup>384</sup> Anaxagoras, the Atomists, Plato.

ment of complex bodies the principle of action-passion. For alteration and combination are impossible without an agent and a patient. This process of interaction itself implies a substrate of the qualities involved in the process, for any given quality cannot itself change into its opposite; and thus far Diogenes of Apollonia was right in claiming that all things affected by one another must be derived from a single substance.<sup>385</sup> Change which is a process from contrary to contrary is the result of interaction as all Aristotle's predecessors admit; the impossibility of direct interaction between contraries necessitates a third term which, conceived as the subject of contrary predicates, will serve as the physical substrate of contrary qualities.<sup>386</sup>

The two notions of logical predication and physical interaction are identified by means of the ambiguity of the terms "potential-actual" on the basis of which the Presocratic theories of interaction are criticized. Most thinkers had supposed that only dissimilars could interact, since similars are identical in the nature and degree of their characteristics; Democritus alone, according to Aristotle, dissented in his theory that agent and patient, as such, must be similar.<sup>387</sup> This difference of

<sup>385</sup> Cf. Diogenes of Apollonia, *fragment* 2 (Diels). Aristotle tries to discover his own motives in Diogenes. Aristotle remarks parenthetically, however, (lines 19-21) that not all things are so related to the substrate, since there are some things (by which he means the οὐρανός) which are not involved in this process of interaction.

<sup>386</sup> *Metaphysics* 1075 A 28-34. The logical background of the theory is revealed in *Physics* 190 B 29-191 A 3.

<sup>387</sup> *De Generatione* 323 B 1-15. This is an amazing classification in view of the fact that the principle *ἁμοιον ὁμοιω* is attributed to Diogenes a page above (322 B 13-15) and is attested elsewhere for Heraclitus (*De Anima* 405 A 25-28), Anaxagoras (*Physics* 203 A 23 ff. and Simplicius *ad loc.*), and Empedocles (*De Anima* 409 B 23 ff., 416 B 33 ff.), and for all explanations of growth (*De Generatione* 315 B 1-3). In *De Anima* 410 A 23-26 Aristotle accuses Empedocles of inconsistency in holding that similars are mutually impassive and yet that sensation and intellection which are types of interaction are based upon the principle *ἁμοιον ὁμοιω*. Theophrastus claims that Heraclitus explained perception by the interaction of dissimilars (*De Sensibus*, 1) and even suggests that Democritus may have done the same (*De Sensibus*, 49, 72). This interpretation is due to his Peripatetic theory of alteration in which the terms of the process are contraries. Heidel (*op. cit.*) has shown that it was Aristotle's attempt to import



opinion is exemplified in the problem of nourishment and growth, which was a favorite form of the puzzle of change for the Greeks. Here, too, Aristotle says,<sup>388</sup> some held that like was nourished by like while others considered nourishment and the object nourished to be dissimilar and believed that an alteration took place in the nourishment in the process of assimilation.<sup>389</sup> And both views are partially correct but neither comprehends the whole process, for, if the nutriment be considered in its undigested state, nutriment and the object nourished are contraries but, if nutriment means that material on the point of assimilation, like is nourished by like.<sup>390</sup> In the more technical terminology the nutriment is potentially the same as the body to be nourished but actually other than it;<sup>391</sup> consequently

into Presocratic thought his own notion of alteration which made him think he found in these theories interaction between dissimilars. He may have thought that he had evidence to support such an interpretation in the Presocratic doctrines of psychological contrast. (Cf. *Nicomachean Ethics* 1154 B 7-9, a reference to Anaxagoras. Cf. Burnet *ad loc.* and Heidel, *op. cit.*, pp. 358, 371.)

In *Nicomachean Ethics* 1155 B 1-9, dismissing as alien to the investigation physical explanations of love and friendship, he says that Empedocles among others made it a desire of like for like while Heraclitus (and Euripides) explained it as the attraction of opposites, for which interpretation he quotes Heraclitus' saying, τὸ ἀντίξουν συμφέρον κ. τ. λ. (*fragment* 8, Diels). Plato, *Lysis* 214 B-D, implies that the formula ὁμοιον ὁμολῶ was universal among the Presocratics.

<sup>388</sup> *De Anima* 416 A 29-B 9.

<sup>389</sup> Aristotle himself has attributed to the Atomists the former doctrine; and we have direct evidence to show that Empedocles (*fragment* 90) and Anaxagoras (*fragment* 10; cf. Simplicius, *Phys.* 460, 10 ff.) held the same view. The peculiar view attributed to certain Pythagoreans (*De Sensu* 445 A 16 ff.) is not concerned here. The Milesians, as well as Diogenes, must have held the doctrine of ὁμοιον ὁμολῶ throughout. Possibly such remarks as τὸ ἀντίξουν συμφέρον (*fragment* 8, Diels) might have given an opportunity to attribute the second doctrine to Heraclitus. (See page 91, note 387.) The notion that the nourishment and nourished are dissimilar is the common naïve opinion and Aristotle's own words at 416 A 21 introduce it as such (cf. *δοκεῖν Index Arist.*, 203 A 7 ff.).

<sup>390</sup> *De Anima* 416 B 3-9. The passage, 416 A 34-B 3, is a parenthetical remark induced by the word μεταβάλλειν in the account of the theory criticized. Although there must be interaction, still in the sense that a new form is imposed upon the nutriment it is rather the nutriment than the nourished that is acted upon. (Cf. *De Generatione* 322 A 10-13: the agent of growth is in the nourished body and brings the nutriment to its actuality.)

<sup>391</sup> *De Generatione* 322 A 4-6.

all growth implies alteration in this sense of the actualization of the potential similarity inherent in contrary terms<sup>392</sup> while every contrariety implies potential assimilation. The final explanation of the possibility and necessity of this process, the logical formula that the agent and patient are identical generically and contraries in species, is a corollary of the doctrine that all change, occurring as it does between contrary terms, is the result of the interaction of contraries and contraries exist always in a single genus.<sup>393</sup> The apparent disagreement of the two usual explanations is due to the ambiguity of ordinary speech which represents as the patient sometimes the substrate or subject, sometimes one of the contraries. So Aristotle supposes that those who explained alteration as the interaction of similars did so because of their exclusive attention to the substrate, while the opposite opinion arose from undivided concern with the rôle of the contrary terms of the process.<sup>394</sup> This historical hypothesis assumes that earlier thinkers shared his own conception of the nature of contraries; but, once accepted, it leads directly to a misinterpretation of the theory of change held by such pluralists as Anaxagoras and Empedocles. It ought, however, to have made him attribute to all the monists the doctrine of the affection of like by like.

Aristotle also defends—and develops—the objections brought by either opinion against the other.<sup>395</sup> If the terms of the relationship are identical in nature, there can be no distinction of agent and patient and everything must act upon itself with the result that an eternal or immovable object could not exist. But interaction between terms absolutely different is also impossible as change from contrary to contrary proves, since contraries are by definition specific differentiations of something

<sup>392</sup> *Physics* 260 A 29-33.

<sup>393</sup> *De Generatione* 323 B 29-324 A 14. This doctrine of alteration is used to refute the theory held by "certain Pythagoreans" that some animals are nourished by odors (*De Sensu* 445 A 16-30). Although Aristotle brings against the theory the empirical evidence that the receptacle of food in animals is spatially distinct from the organ of smell, that evidence is only supplementary to the argument that the nourishment must be both composite and solid since the objects nourished have both of these characteristics.

<sup>394</sup> *De Generatione* 324 A 14-24.

<sup>395</sup> *De Generatione* 323 B 18-29.



identical with itself. The necessary element of identity in agent and patient is supplied by the material substrate; the contrary terms which furnish the requisite differentiation are active and passive not in themselves but only as informing this matter. That this is merely a translation into physical language of the logical doctrine that a genus exists only in its specific differentiations and is exhausted by them is clear from Aristotle's own words.<sup>396</sup>

Passing on to a discussion of the mechanism of interaction, Aristotle outlines and criticizes the theory which explains the process by means of effluences and pores and that which uses atoms and void.<sup>397</sup> Empedocles, among others,<sup>398</sup> accounted for interaction, sensation included, as well as intermixture by the intrusion of the particles of one object into the pores of another. The transparency of some bodies is due to the greater number of close-set pores which run through them.<sup>399</sup> In the case of intermixture the pores of each of the bodies to be mixed must

<sup>396</sup> *De Generatione* 324 B 4-22, N. B. 6-7; cf. *Metaphysics* 1038 A 5-9, cf. Baeumker, *op. cit.*, p. 221.

<sup>397</sup> In *De Generatione* 325 B 25-33 Plato's construction of bodies is said to be essentially the same as that of Democritus. The differences listed are the following: Plato made the atomic elements planes instead of solids, the elemental figures limited in number instead of unlimited, and the means of generation and destruction contact alone instead of contact and void, the instruments used by Democritus.

<sup>398</sup> *De Generatione* 324 B 26-35. The "others" are probably Gorgias and his followers (cf. the connection of Gorgias and Empedocles in this respect by Plato, *Meno* 76 C-D, who implies that all pupils of Gorgias learnt the theory: N. B. λέγετε, C 7; κατὰ συνθήκειαν, D 8). It is true that Alcmaeon of Croton believed that the sensations pass through "pores" (Theophrastus, *De Sensibus*, 26), and Empedocles may well have developed his theory from this discovery; but there is no hint that Alcmaeon explained change in general by pores and effluences.

<sup>399</sup> Philoponus supposes that lines 29-32 refer not to the possibility of effluences passing through transparent bodies to the eye but to the "ray of vision" passing from the eye through the transparent body to the object of vision. But the tone of Aristotle's remarks implies that he is recounting a single theory, and it is not probable that he would have failed to emphasize the inconsistency of these two explanations if he had had both of them in mind, since he makes much of the inconsistency when he does give both explanations (*De Sensu* 437 B 26-438 A 5).

be proportionate to the particles of the other.<sup>400</sup> The theory of Leucippus and Democritus is more thorough and systematic and has a more scientific basis,<sup>401</sup> for it satisfies the problem of identity and difference by positing an infinite number of atomic bodies, each of which is an unalterable plenum of

<sup>400</sup> This is the only possible meaning, I take it, of the carelessly written *οἱ πόροι σύμμετροι πρὸς ἀλλήλους*.

<sup>401</sup> *De Generatione* 324 B 35-325 A 2. From here to 325 A 29 Aristotle gives what purports to be the historical background of Atomism:—some of the ancients claimed that Being was one and immobile on the ground that there is no void to separate existing things and offer a field of motion. (This is the Eleatic argument against certain forerunners who posited a plurality of existences and a void, possibly "Pythagoreans." Cf. *Physics* 213 B 22-26, cf. Burnet, *E. G. P.*<sup>8</sup>, p. 314.) They also claimed that their objections still hold against the theory that the universe is not continuous but consists of discretes in contact, for they argued that what is divisible throughout is not a unity and without a unity there is no plurality but only vacuity (it would be pure fiction to posit limited divisibility), while motion is still inexplicable on this theory which allows no void. (The theory here refuted is apparently that of Empedocles; the refutation bears the mark of Zeno, cf. Eudemus *apud* Simplicius, *Phys.* 99, 13-18; and, since Suidas reports that Zeno wrote a work against Empedocles, this part of the argument seems to represent an Eleatic attack on Empedocles who had attempted to evade the difficulties previously raised by Parmenides. [So also Joachim: *On Coming-to-Be and Passing-Away*, p. 161.] They (i. e. Eleatics) rejected the evidence of sensation and in strict consistency claimed that the Universe is an immobile unit, while some of them added that it is infinite since a boundary would abut on the void (i. e. Melissus). But Leucippus thought he could save the phenomena of plurality and change without transgressing the logical axioms of the Eleatics. He admitted that a void is a prerequisite of motion and that the void is non-Being, also that non-Being is no part of what exists since the truly existing is a plenum. His atomic theory was thus an attempt to reconcile Eleatic logic with phenomena. This passage represents the doctrine of Empedocles as having been an attempt prior to that of the Atomists to meet the Eleatic objections to plurality and motion; the development here implied is:—Parmenides attacks the pluralists (as represented by the "Pythagoreans"?); Empedocles attempts to restate the case for pluralism without recourse to a void; the Eleatics (Zeno) prove that the theory of Empedocles really assumes a void and fails to meet the logical requirements of "unity"; Leucippus finally constructs a pluralism on the Eleatic theses of the void as non-Being and the indivisibility of Being. (Burnet, *E. G. P.*<sup>8</sup>, 334 ff., mistakes the full implication of the passage by supposing that it contains only Pythagorean, Eleatic, and Atomistic doctrines.) Whether this account represents a real historical tradition, however, or is only a logical reconstruction of Aristotle's is another matter; cf. *Metaphysics* 984 A 16-B 1 (pages 220-221 *infra*).



Being, moving in the void which *is* non-Being and it explains action and passion as well as generation and destruction by the casual contact of these atoms which retain their self-identity in all circumstances.<sup>402</sup> This account of alteration and interaction by means of atoms insinuating themselves into the void which separates other atoms is simply a development of the theory of Empedocles according to Aristotle, for, unless Empedocles would take the impossible position that the supposed pores are continuous and so assert that everything is vacuity (as the Eleatics urged against his theory),<sup>403</sup> he must admit the existence of indivisible solids between which there is vacuity.<sup>404</sup>

The explanation of the complex world of phenomena on the basis of atomic elementary bodies differentiated by shape alone has to Aristotle's mind the advantage at least of consistency over the theory of Empedocles which posits massive elements without accounting for their genesis or destruction and without ever being able to do so save by assuming elements prior to the so-called "four elements."<sup>405</sup> Still, consistent as the atomic doctrine of interaction is, it rests upon the assump-

<sup>402</sup> *De Generatione* 325 A 29-36. Here (325 A 23 ff.) the theory is attributed to Leucippus without mention of Democritus, though the reasoning that the true unit is indivisible and that no true unity can arise out of two units (325 A 34-36) is attributed to the latter in *Metaphysics* 1039 A 9-10. See also the outline of the theory in Aristotle, *fragment* 208 (possibly from a work of Theophrastus) where only Democritus is mentioned.

<sup>403</sup> *De Generatione* 325 A 6-10, cf. page 95, note 401 *supra*.

<sup>404</sup> *De Generatione* 325 A 36-B 10.

<sup>405</sup> *De Generatione* 325 B 13-25. To believe that the four common elements are ultimate seemed to Aristotle too absurd to attribute even to Empedocles, although he cites Empedocles' doctrine to this effect, 329 B 1. He consequently supposed that Empedocles did *not* believe them to be ultimate but was unable to explain their origin and generation. As Burnet says (*E. G. P.*<sup>3</sup>, p. 230, note 3), Plato's criticism had made it impossible for Aristotle to understand how Empedocles could have considered his "four roots" to be ultimate elements; but there are further reasons for his confidence in stating that the theory of Empedocles requires "generation of the four so-called elements." Since he has interpreted the "Sphere" as an approximation to his own "prime matter" and the process from the "Sphere" to the organized world as a "separating out of contraries," he can find in Empedocles' own cosmogony an account which presupposes a state of matter prior to the "four roots" without any explanation of the intermediate transformation. (Cf. pages 36, note 135; 50-51 *supra*).

tion that the atoms themselves are impassive; and Aristotle addresses himself to prove that this assumption is impossible.<sup>406</sup> In the first place, the atoms, so considered, could not affect anything else. This deduction depends upon Aristotle's axiom, that interaction can occur only when agent and patient have contrary qualities,<sup>407</sup> and is connected with his antipathy to the derivation of sensible qualities from quantitative determinations.<sup>408</sup> But the atoms are without qualities<sup>409</sup> and so, being contrary to nothing, cannot affect anything any more than they can be affected. There seemed, moreover, to be a patent contradiction in this portion of atomic theory ready to Aristotle's hand in that heat was attributed to the spherical atom;<sup>410</sup> in that case, he asks, how can the Atomists refrain from assigning the contrary of heat to a specific figure?<sup>411</sup> And, if the atoms have these qualities, why can they not have others? Democritus does admit that every atom has relative weight;<sup>412</sup> but it must fol-

<sup>406</sup> *De Generatione* 325 B 34-326 B 6.

<sup>407</sup> See page 89, note 377; *De Generatione* 323 B 28 ff.

<sup>408</sup> See page 8 *supra*.

<sup>409</sup> In *Metaphysics* 1042 B 11-15, in discussing the "actualized substance of perceptibles," Aristotle claims that Democritus seems to think there are but three differentiae of such existence, figure, position, arrangement, the material substrate of all being identical. Aristotle gives, on the other hand, a long list as an example of the multiplicity of differentiae. This disregards the distinction which the Atomists made between the differentiae of complexes and the limited set of differentiae of the atoms themselves. Here, too, the disagreement is concerned with the possibility of deriving qualitative from quantitative difference.

<sup>410</sup> See *De Caelo* 303 A 14; 306 B 32-33; in *De Anima* 403 B 31-404 A 5, 405 A 8-13 Democritus (and Leucippus) are credited with "making both soul (or *voûs*) and fire spherical atoms." Democritus, evidently, did not believe that he was assigning a quality to the spherical atom; heat was to be an "epiphenomenon" arising from the contact of the swiftly moving spherical atoms with other congeries of atoms. But such a connection between the shape of a particular atom and the resulting quality amounts almost to making the quality primary. (Cf. Heidel, *op. cit.*, p. 373.)

<sup>411</sup> See page 12, note 47 *supra*.

<sup>412</sup> Joachim paraphrases (*op. cit.*, p. 165) "Democritus attributes not only heaviness to them, but different degrees of heaviness." The statement in *De Caelo* 308 A 9-11 shows that Aristotle did not mean to say that Democritus attributed absolute weight to the atoms. Dyroff (*op. cit.*, 31-39) and Burnet (*E. G. P.*<sup>3</sup>, 341 ff.) prove that only in the cosmogonical vortex did the atoms display an activity that may be expressed by calling some "heavier" than others;



low, then, that *relative* heat is a characteristic of each and every atom.<sup>413</sup> But of this interaction is a necessary consequent, for that which is slightly cold must be affected by what is very

and it appears that Aristotle never says anything to controvert this interpretation. Joachim further takes *κατὰ τὴν ὑπεροχὴν* to mean that the weight of the atoms varies directly with their size. That this was the Atomistic doctrine Theophrastus testifies (*De Sensibus*, 61; cf., however, Aëtius, I, 3, 18; I, 12, 6; page 211, note 253 *infra*); but the words here do not say so. Dyroff, who took *κατὰ τὴν ὑπεροχὴν* as Joachim does, seeing that the sentence makes no sense, thought the word *ἐκαστον* corrupt. It is obviously nonsense to say that *each* atom is heavier in accordance with its greater magnitude. But *ὑπεροχή* does not mean "excess magnitude"; it always takes its specific meaning from the context, and there has been no mention of size in this passage (cf. *Nic. Eth.* 1158 B 11-12, *Physics* 215 B 16-18 where distance, time, and velocity are concerned). The "difference" expressed by the word may be anything measurable (cf. *Hist. Animal.* 486 B 6-17). Further, *καθ' ὑπεροχὴν* is frequently used instead of the fuller *καθ' ὑπεροχὴν καὶ ἑλλειψιν* (cf. *Hist. Animal.* 486 B 6-17 with 528 B 13-14 and *De Part. Animal.* 644 A 17-23; 645 B 22-26), the meaning of which is "in respect of the quantitative comparison" of two objects. Such a comparison to determine heavy and light consists in weighing one against the other (cf. for this use of a pair of words to express one abstract notion, Plato, *Euthyphro* 7 C). *κατὰ τὴν ὑπεροχὴν*, then, means "in respect of a *particular* comparison." Nor does *βαρύτερον* mean "heavier." *τὸ κουφότερον* (*De Caelo* 309 B 5-8, cf. 299 B 1-4) clearly means "the relatively light"; if *βαρύτερον* here means "relatively heavy" (cf. Kühner-Gerth: *Griechische Grammatik*, II, 2, p. 306), *ἐκαστον* is no longer meaningless. "Democritus says that each and every atom has relative weight when compared (with any other)." See next note.

<sup>413</sup> The connection of this argument with the preceding sentence requires the interpretation given in the last note. Joachim follows Philoponus in interpreting: "So that, if the larger atoms are heavier, the larger spherical atoms are heavier." There is no mention of spherical atoms, however; and the sentence-structure requires that *κατὰ τὴν ὑπεροχὴν φησιν εἶναι ἐκαστον τῶν ἀδιαίρετων* be carried over. Yet, if we follow Joachim in translating: "each of the atoms is heavier because of its mass," we shall have to go on to say: "therefore, *each* is hotter because of its mass." This is absurd. Moreover, even if we smuggle in a *σφαιρικῶν* with Philoponus, the argument is inconsequential, for it has not been shown that the Atomists supposed the *spherical* atoms to vary in size, and, even if this were the case, it distinctly does *not* follow that, if heat is a concomitant of spherical shape alone, the bigger sphere must be hotter than the smaller. Such an interpretation implies that Aristotle thought a large sphere more spherical than a smaller one. Moreover, it is certain that in the following sentence Aristotle tries to conclude from the argument here that the atoms in general, not merely the spherical atoms, affect one another. The argument is, rather, *a fortiori* (note: *καὶ τοὶ βαρύτερον γε . . . ὥστε δῆλον*): Democritus has

warm.<sup>414</sup> Furthermore, as solid bodies the atoms must have some rigidity; <sup>415</sup> but, if hardness be attributed to them, so must softness.<sup>416</sup> These qualities imply interaction, however, for they themselves merely express the tendency of a body to yield to pressure in a certain degree. The tacit assumption here made by Aristotle that such a tendency must be manifested in different degrees between two contrary extremes is a result of his rigid application of the theory of the contrariety of qualities to all forms of interaction. The translation of the doctrine that the atoms yield to pressure in no degree into his own phraseology, "the atoms have the quality of hardness," loses its innocence when one remembers that for him "hardness" and "softness" imply a qualitative differentiation of matter; <sup>417</sup> the inconsistency here developed in the Atomistic theory is due to the implications of Aristotle's technical terminology.

As it is absurd to suppose that the atoms differ only in figure, so the contention that they have uniformity of substance is irreconcilable with the supposition that each atom has one quality besides figure, for, as Aristotle supposes he has proved, a given quality of one atom implies the contrary quality of some other atom. At the same time, the indivisibility of the atom prevents

paradoxically denied weight to the atoms although he has endowed some atoms with heat. Yet, having denied that the atoms are heavy or light, he asserts that in comparison with one another they have *relative* weight. Obviously, then, since he has admitted that some have heat absolutely, each and every atom must have relative heat in comparison with any other. This argument is parallel to that in *De Caelo* 307 A 13-18 where it is argued that, if the potency of burning be explained by the angles of certain figures (e. g. a pyramid), it follows that all figures must have the same potency to a greater or less degree since all have angles, even the sphere of Democritus being in itself a kind of angle (cf. pages 11-12 *supra*).

<sup>414</sup> With a correct interpretation of the passage it is no longer necessary to change the MSS from *ψυχρόν* to *θερμόν*.

<sup>415</sup> The plenum of Democritus is called by Aristotle *στερεόν* the void *μανόν* (*Metaphysics* 985 B 6-7); and since the "solid" does not yield to pressure it is *σκληρόν*, for the definition of *σκληρόν* is *τὸ μὴ εἰς ἑαυτὸ ὑπείκον*. The same conclusion can be reached from the indivisibility of the atom (cf. *De Caelo* 299 B 13-14).

<sup>416</sup> That which possesses one extreme of a single quality must have the potentiality of the other.

<sup>417</sup> *De Generatione* 330 A 8-29.



it from having a multitude of qualities, for it would in that case be susceptible to the alteration proper to one quality while exhaustively qualified by another; for example, quâ hot it would not only be cooled but capable of yielding to pressure. This difficulty oppresses all theories which posit indivisible elements, for the unalterable intensity and uniform substantiality of the indivisibles prevent them from possessing the qualities which they nevertheless must possess if they are to be elements of natural bodies.<sup>418</sup>

After a parenthetical objection that such theories can give no reasonable explanation of the fact that their indivisible elements are all too small to be seen, for there is no reason why indivisibility as such should be a property of small bodies rather than large ones,<sup>419</sup> Aristotle continues to criticize atomic bodies on the ground of the laws of interaction. If the substance of all the atomic bodies is uniform, as the Atomists insist,<sup>420</sup> by what principle of differentiation do they retain their own identity when they come into contact instead of

<sup>418</sup> The argument is outlined in the course of refuting the theory of "indivisible lines," *De Caelo* 299 A 17-25. Aristotle also ridicules the attempt of such theories as those of Plato and the Atomists to explain alteration by reducing qualitative differences to atomic figure by arguing (*De Caelo* 307 A 24-31) that, if fire is merely spherical or pyramidal figures, the inflammable should when burning be changed into spheres or pyramids, but that to argue that a pyramid must create pyramids in this way is equivalent to saying that a knife must cut an object into knives. This refutation, though pretending to apply to the Atomists as well as Plato, takes cognizance only of the latter (for a defense of whom on this point cf. Proclus *apud* Simplicius, *De Caelo*, p. 666, 9 ff.), since the Atomists could not change the shape of the atoms in a complex body into spheres but only had the fire break down the object into its component atoms or groups of such atoms.

<sup>419</sup> This objection is held to be valid against all theories that posit indivisibles and is suggested by the foregoing generalization of the criticism of the Atomists. Although Aristotle here says that from the ordinary view it is reasonable that larger bodies are more easily broken up than smaller ones, he himself believes that of "natural bodies" the smaller are more liable to dissolution. See *De Caelo* 305 A 6-13 and page 59 *supra*. According to Aëtius (*Doxographi Graeci*, p. 311, 21-22) Democritus said it was possible for an atom to be the size of a whole world.

<sup>420</sup> Cf. *De Caelo* 275 B 32.

merging into another unity as two drops of water do? <sup>421</sup> But, if there are groups of indivisibles which are qualitatively differentiated, this qualitative differentiation should have been explained and the bodies so differentiated rather than the figures as such should have been designated as the principles. Such a differentiation, moreover, would necessitate mutual affection of the indivisibles themselves when in contact with one another.<sup>422</sup>

Furthermore it is "atoms in motion" which is the principle of interaction for this theory; but the cause of this motion presents an inescapable dilemma. If it is something other than the atoms, they are not impassive; and, if each atom is self-moved, it is no longer indivisible<sup>423</sup> or it will be, as self-identical, the subject of contraries in the same respect and so not merely a numerically identical substrate of contrary qualities but a potentially identical substrate as well.<sup>424</sup>

<sup>421</sup> Cf. Aristotle, *fragment* 208 (p. 166, 14-17, ed. Rose) and *De Generatione* 325 A 33-36. The uniformity of substance has been previously attacked on the ground that it would necessitate a uniformity of natural motion (cf. pages 7 and 16 *supra*), and it is elsewhere used to reduce Atomism to identity with the material monism of the Ionians (cf. pages 17-18 *supra*).

<sup>422</sup> Joachim claims that the statement at 325 A 32-34 implies that Leucippus himself maintained precisely this; but 325 B 2 ff. makes it clear, if further proof be necessary, that Leucippus did not consider the atoms themselves capable of alteration or affection of any kind (cf. also *De Generatione* 315 B 6-9; Simplicius, *De Caelo* 242, 16-26). It is clear from 326 A 1-3 that the Atomists held the atoms to be impassive but went on to explain alteration etc. by the *action* of the atoms upon the construction of a complex, the qualitative alteration being an epiphenomenon of the mechanical rearrangement (cf. *De Generatione* 315 B 9-15). The words at 325 A 32-34 are ambiguous because of the conciseness; the *ποιεῖν* Leucippus would have attributed to the individual atoms, but the *πάσχειν*, had he used it at all, would have been attached to the complex object into the vacant interstices of which the approaching atoms insinuate themselves. But Aristotle disregards entirely the attempt to distinguish between mechanical interaction and qualitative alteration; his argument finally depends upon his thesis that sensible qualities must be primary and irreducible; the evident inability of the Atomists to exclude all specific difference from their account of the atoms gave him a specious support for his interpretation, which, however, was due chiefly to the fact that the concept of "activity" implied for Aristotle his own interpretation of *πάσχειν* which could not be divorced from the notion of an alteration involving contrary qualities.

<sup>423</sup> Cf. *Physics* 257 B 6-13.

<sup>424</sup> Cf. *Physics* 217 A 21-26; 192 A 3-12. The substrate, though numerically



This critique, with the exception of the general reference to all theories positing indivisibles and the interjected remark on the size of such indivisibles, falls into three parts, in each of which Aristotle attacks the two characteristics of the atoms as elements of alteration, their impassivity, and their substantial identity and concomitant individuality. By the hypothesis of the Atomists, the atoms are impassive. If so, they must be inactive, that is, incapable of producing an alteration of quality. Yet they can be proved to have qualities, and so they must be acted upon by one another; in which case they can be neither indivisible nor substantially identical. If they have substantial identity, they cannot maintain their separate individuality, and physical contact should result in fusion; but, if they are not substantially identical, their qualitative differentiations are the real elements of alteration, and the atoms must in consequence affect one another. Lastly, if they are not self-moving, they are not impassive; if they do move themselves, they are not indivisible or self-identical.

The theory of Empedocles, Aristotle has maintained, must end in atomism if it be consistently developed; consequently, the objections to the atoms as elements of interaction hold for Empedocles also, but at the end is added a direct attack on the mechanism of pores.<sup>425</sup> If the pores are not empty,<sup>426</sup> the penetration of the agent is not facilitated by them and one might as well suppose bodies to be continuous. In the explanation of transparent objects, for example, the passage cannot be clear through pores that are full of matter nor can the mathematical lines of contact which are the boundaries of the pores furnish a passage-way for physical effluences.<sup>427</sup> It will not help to suppose that the pores *as such* are empty but are in fact always full of matter, nor to say that they are too narrow to admit the penetration of material bodies. That would amount to saying

one, as the substrate of opposites is potentially the contraries; if it were potentially identical, its actualization would have to be one and identical.

<sup>425</sup> *De Generatione* 326 B 6-28.

<sup>426</sup> See Empedocles, *fragments* 13 and 14.

<sup>427</sup> Joachim follows Philoponus here also in supposing that the subject of διέναι is ὅψεις. Cf. page 94, note 399 *supra*.

that there can be a small void but not a large one, whereas "the void" means only a place capable of containing a body but deprived of it. These objections really avoid the point, however; it is obvious that Empedocles never meant that pores were *empty* because of their infinitesimal size but only that the size of the various pores prevented the entrance of certain bodies and admitted others. Besides, if Empedocles or his followers said that the pores *as such* are empty but are in fact always filled up by matter, the meaning was not that the pores and the bodies filling them are distinguishable in thought.<sup>428</sup> That is an Aristotelian distinction that would have seemed meaningless to Empedocles; and it tacitly assumes that the pores must be always full of the *same* matter, whereas one example of the mechanism surviving in the words of Empedocles himself indicates that he thought of the pores as constantly filled with a continuous flow of different matter.<sup>429</sup> The intruding matter does not pass through the filling of the pores; it replaces what is there by extrusion and passes through the pores as such. The river-bed and the water in it are differentiated in fact, not merely in thought. Aristotle's telling criticism is quite a different one. The theory of pores assumes that interaction is explicable as mechanical contact; if so, the pores are useless, for there would be interaction without pores between objects which stand in the natural relationship of agent and patient; and, if interaction is not explicable as contact, contact within a body explains no more than surface contact. Aristotle, of course, is thinking of alteration here; and Empedocles had constructed his theory on the assumption that, real change being impossible, its apparent occurrence must be explained by mechanical rearrangement at the level of the unalterable elements. Apart from the fact that he could not carry out the system consistently, the fundamental assumption of his attempt was that the quantitative variations of a limited number of qualitatively different elements, in themselves unalterable, could account for the multiplicity of phenomena. Aris-

<sup>428</sup> Although the language of Aristotle's objection is not so explicit, Joachim is certainly right in taking this to be the meaning.

<sup>429</sup> *Fragment* 100.



totle's opposition rests upon his firm conviction that qualitative alteration cannot be explained by the juggling of unalterable quanta; his multiplication of objections really beclouds the issue. The fact of qualitative alteration cannot be "explained away" by the mechanistic theories against which Aristotle argues; but his own solution is rather a recognition of the real problem than an explanation; the kernel of all his complicated theory of alteration appears unadorned in this passage. With or without pores, action and passion are due to the fact that, in the relationship of alteration, one term by its essential nature affects the other the nature of which is to be so affected. What is the use of pores, he asks, if body is by its very nature divisible? Quâ divisible it can be at any time and at any point divided by the appropriate agent. He might have added once and for all that no mechanism is useful, his own included; the "actualization of the potential" is at best an admission that the fact is real and the cause inscrutable. But from the axiom that an object which is actually qualified in a certain way is so qualified because it previously had this quality in potentiality Aristotle concludes that this potentiality must pervade the whole body;<sup>430</sup> and this he considers a fundamental principle which is violated by all who construct bodies of discrete parts. He is willing to concede that the potentiality may be of varying degrees in various parts of the bodies, and he suggests that one might speak of pores in the sense of "veins" of more intense susceptibility to alteration running through the body which, however, must have the same potentiality throughout though in different degrees. Theories<sup>431</sup> which posit indivisibles, whether solids or planes,<sup>432</sup> deny that bodies are susceptible throughout and so deny that any body is continuous.<sup>433</sup> But, if bodies are continuous, any body is potentially divisible at every point<sup>434</sup>

<sup>430</sup> *De Generatione* 326 B 31-327 A 1.

<sup>431</sup> *De Generatione* 327 A 6-29.

<sup>432</sup> I. e. the Atomists and Plato.

<sup>433</sup> The indivisible constituents are obviously incapable of alteration at all; consequently the complex body is not thoroughly susceptible. But the complex body cannot, then, be continuous. Cf. *Physics* 227 A 10-15, 231 B 11-18; *De Caelo* 306 B 22-25, pages 10-11 *supra*.

<sup>434</sup> Cf. *Physics* 185 B 10, 200 B 16-20, 231 A 21-29.

and the theory that action-passion occurs only at the points of contact of the constituent parts is itself transformed to mean that any body is susceptible of alteration throughout its whole extent. But, even corrected in this way, these theories restrict interaction to the mechanical process of a disruption of the patient's constituent parts by intrusion of the agent and so do away with alteration. Aristotle appeals to the evidence of sense-perception; we see one and the same continuous body now liquified and again solid and we *see* that these changes are not the result of division, concretion, or any of the mechanical rearrangements which Democritus assigns as the cause. We can see that there are no solid indivisible particles in the substance which is entirely and homogeneously liquified; and without any displacement or rearrangement of its particles we see that from a liquid it has become a solid. The appeal to sense to refute a theory that asserts the invisibility of its elements seems naïve; but Aristotle probably feels that, although the motion of a single atom might be imperceptible, if all or many of the atoms in a finite quantity of liquid are in motion, there ought to be some visible motion of the whole and that, if, as the Atomists say, *all* the atoms of a liquified body are solid, we should be able to perceive the solidity, if not of any one individually, of a group of them together.<sup>435</sup>

Finally such a theory of interaction cannot account for growth and wasting (i. e., organic growth and decay), for in this process the increase and decrease is manifested in each and every part which implies, instead of mere accretion, that the entire organism has changed whether by intermixture of some alien body or alteration in itself.

The remark that such theories allow no place for alteration leads us to those passages in which Aristotle makes use of his own distinction between alteration and genesis to carry on in more detail his criticism of the account of interaction given by the Presocratics. All his predecessors he believes may be divided into two classes, those who identify genesis with alteration and those who allow for the two as essentially different processes.<sup>436</sup>

<sup>435</sup> Cf. *De Sensu* 445 B 29-446 A 20 and page 5, note 18 *supra*.

<sup>436</sup> *De Generatione* 314 A 6-13.



Such a distinction is not to be found in the words of the Presocratics themselves; but Aristotle argues that all material monists *must* consider genesis to be an alteration of their one primary matter and that all pluralists such as Empedocles, Anaxagoras, and Leucippus have to distinguish between genesis and alteration.<sup>437</sup> Although he believes that he can find indications of such a distinction in the words of Empedocles and the Atomists, Anaxagoras was so outspoken in his denial that there was nothing to do but claim that he misunderstood his own language in that, while he asserts a plurality of elements, he still *says* that generation and destruction are the same as qualitative alteration (*ἀλλοιοῦσθαι*).<sup>438</sup> It is only because Aristotle here has uppermost in his mind the infinite number of Anaxagoras' elements of composition that he insists upon introducing this distinction into his system; elsewhere not only Anaxagoras but even Empedocles was classed with Anaxi-

<sup>437</sup> In *De Caelo* (298 B 12-299 A 1) the problem as to whether there is genesis opens with a different classification. Besides those like Melissus and Parmenides who altogether denied generation and destruction, there were: 1) Hesiod and his followers and *οἱ πρῶτοι φυσιολογήσαντες* who claimed that all things were the result of generation but some were indestructible. (Simplicius, p. 560, 16, identifies these as the cosmological poets, Orpheus, Musaeus, *et al.*) 2) The apparent theory of Heraclitus and many others was that there is only one persistent being of which all others are temporary configurations. 3) Some generate all bodies by concretion of planes (Plato and Xenocrates). Later (300 A 14-19) the Pythagorean theory which constructs bodies of numbers is treated as equivalent to the Platonic doctrine (cf. pages 38-40 *supra*). In this passage the term *μετασχηματίζεσθαι* (298 B 31), used to describe the process of the monists, is more historical and exempt from the false implications of *ἀλλοιοῦσθαι* used in *De Generatione* 314 A 10-11 (cf. Heidel, *op. cit.*, pages 364-5). Moreover, the pluralists, here represented by Plato, are not distinguished from the monists by preserving the difference between genesis and alteration. This distinction and its implications are not mentioned in the *De Caelo* where the problem of genesis is restricted to the aspect of the number of "elements" and the possibility of their generation from one another.

<sup>438</sup> *De Generatione* 314 A 13-16. Aristotle means that Anaxagoras did not understand that the identification of genesis and alteration implies material monism (cf. Heidel *op. cit.*, p. 369, note 112). It is improbable that Anaxagoras used the word *ἀλλοιοῦσθαι*; but, if he did, he must have meant nothing other than Heraclitus (*fragment* 67) who uses it of a change caused by physical intermixture of incense with fire (N. B. also the Hippocratic *De Victu*, 4: *συμμισγόμενα δὲ καὶ διακρινόμενα ἀλλοιοῦται*, quoted by Heidel, *op. cit.*, note 64).

mander as a monist;<sup>439</sup> and it is significant for the evaluation of Aristotle's evidence that where he is concerned not with generation and alteration as such but with the history of previous treatments of causality he says clearly that for Anaxagoras generation and destruction were simply aggregation and segregation of the constituent parts of homogeneous bodies.<sup>440</sup>

The confused reports found in Aristotle on this question are due to his desire to make all earlier theories square with phenomena as interpreted by his own terminology. Genesis and alteration seemed to him obviously different processes; and, forgetting that the distinction was his own invention,<sup>441</sup> he thought that it must have been clear in all its implications to the Presocratics also. Consequently his interpretation and even his report of their theories are vitiated by his inability to notice that all of them, monists and pluralists alike, were trying to show that change does not involve genesis and destruction, which they considered unintelligible notions. As for qualitative alteration, none of them thought of it as other than a secondary form of apparent genesis and destruction to be explained by the same mechanical device as would serve for the latter. Until Socrates began to distinguish the quality from the qualified subject it was impossible to treat alteration as distinct from generation; the only refinement possible was that which Empedocles began and the Atomists unsuccessfully sought to complete, the denial that real objects were more than *apparently* qualified.

Although Aristotle elsewhere seeks to show that Anaxagoras,

<sup>439</sup> *Physics* 187 A 20-26, page 50 *supra*. N. B. In 187 A 23 the process of differentiating individual objects from the original "mixture" is represented by *ἐκκρίνουσι* (cf. Anaxagoras, *fragments* 13 and 17; Empedocles, *fragments* 8 and 9; Theophrastus on Anaximander *apud* Simplicius, *Phys.*, 24, 23-25; cf. *ibid.*, p. 27, 11-15), but this is replaced by *ἀλλοιοῦσθαι* seven lines below (187 A 30).

<sup>440</sup> *Metaphysics* 984 A 11-16. Cf. also page 172, note 124 where he claims that all his predecessors made locomotion primary and the *only* motion of their principles and asserts that condensation-rarefaction is locomotion, *not* alteration.

<sup>441</sup> Plato, *Theaetetus* 157 B, *γινόμενα καὶ ποιούμενα καὶ ἀπολλύμενα καὶ ἀλλοιούμενα* (the pairs of terms are "interlaced") is an indication of the type of distinction which may have influenced Aristotle, though the difference here is between change induced by an external agent and that resulting from the inward nature of the subject itself.



Empedocles, and even the Atomists were essentially monists,<sup>442</sup> he does not in those passages appeal for support of his interpretation to the deficiency of their distinctions between genesis and alteration; here, where he is concerned to demonstrate both that pluralism implies such a distinction and that the ancient pluralists vaguely recognized the necessity but met it insufficiently, he is at unnecessary pains to prove that Anaxagoras, Empedocles, Leucippus, and Democritus all had a plurality of material principles,<sup>443</sup> though the nature of these principles differed in the several theories.<sup>444</sup>

<sup>442</sup> See pages 50-51, 18 *supra*.

<sup>443</sup> *De Generatione* 314 A 16-B 1.

<sup>444</sup> The characteristics outlined are the familiar ones; but certain details are interesting. Empedocles posited six elements in all, though only four were corporeal. (In *Metaphysics* 1075 B 3-6 Aristotle says that Empedocles uses *Love* as both efficient cause and material. Burnet and Ross refer to Empedocles, *fragment* 17, to prove that *Love* and *Strife* were "material no less than the other elements." But Aristotle significantly does *not* use any such argument; he thinks *Love* must have been material because it was *μόριον τοῦ μίγματος*, that is, present in the *Sphere*; but this argument depends upon his interpretation of the *Sphere* as an homogeneous compound. Cf. pages 50-51, 57 *supra*. It is possible that Empedocles had not succeeded in stripping his "forces" completely of corporeality; but such phrases as *ἀτάλαντον ἀπάντη* and *ἴση μῆκος τε πλάτος τε* do not necessarily indicate that, and they evidently did not so impress Aristotle. Besides, even if the two forces were not consistently immaterial, they were clearly *not* considered "no less material" than the other four; they can be seen with the mind alone.) Anaxagoras and the Atomists differ from Empedocles in that they posited an infinite number of principles; but for Anaxagoras these were qualitatively different homogeneous bodies, for the Atomists corporeal atoms of infinitely various shapes the position, arrangement, and shape of which cause the sensible differences in the compound bodies they constitute. For Aristotle the fundamental difference between Anaxagoras and the Atomists is that the elements of the former are qualitatively distinguished while those of the Atomists are not (cf. *De Caelo* 302 B 10-303 B 8 and pages 5 ff. *supra*); Anaxagoras and Empedocles both have elements qualitatively distinguished, but, while the latter has only four, the former considers these very four, earth, air, fire, water, to be compounds of the homogenous bodies which are irreducible and elementary (cf. *De Caelo* 302 B 10-303 A 3 and pages 2 ff. *supra*; *Physics* 187 A 23-26 and page 51 *supra*). (The nature of these four bodies is that of a *πανσπερμία*, a collection of all sorts of seeds, for they are compounds and all compounds contain seeds of everything. This I take to be the argument of Anaxagoras compressed in *πανσπερμίαν γὰρ εἶναι τούτων*, for *τούτων* must refer to *σύνθετα* and the argument is general. The sentence is usually interpreted as though it read *ταῦτα γὰρ ἐκείνων πανσπερμίαν εἶναι*.)

It is the persistence of a substrate as one and identical which forces the monists to reduce genesis and destruction to alteration,<sup>445</sup> for a change in the qualities of a persistent perceptible substrate is by definition alteration. But the pluralists must for the same reason distinguish alteration and genesis, for generation and destruction for them is aggregation and dispersion of particles, and this view is supported by reference to Empedocles who said there is no real beginning but only aggregation and dissipation of the aggregate.<sup>446</sup> Although the pluralists, however, should recognize alteration as distinct from generation (for we have ocular evidence that alteration as well as growth and wasting can occur without any change in the essential nature of an object), they have to deny the very possibility of alteration because for them the qualities in accordance with which this process occurs are constitutive differentiae of their elements.<sup>447</sup> Here, as frequently, Aristotle overlooks the fact that the whole explanation of the pluralists rested upon the microscopic nature of their elements; besides, although the criticism that the inherence of the qualities in the essential nature of the elements prevents the possibility of alteration is

<sup>445</sup> *De Generatione* 314 B 1-8. For the definition see 319 B 10 ff. Aristotle's basic difference with the monists is, apart from terminology, the fact that they make the material substrate a *sensible* body, cf. pages 58 ff. *supra*.

<sup>446</sup> The interpretation of Empedocles, *fragment* 8, must be considered in connection with another of Aristotle's references to it. In the present passage the course of the argument makes it certain that Aristotle interpreted *φύσις*, at this time anyway, as "real beginning"; the statement of Empedocles, Aristotle thinks, supports his interpretation of the attitude of *all* pluralists, namely that genesis is different from alteration and is a *concomitant* of aggregation. This doctrine Aristotle will later disprove, for he believes that there is "real genesis"; but the citation of Empedocles is pertinent only if Aristotle thought it meant to replace real genesis by the process of combination. The same distinction between real genesis and apparent genesis due to aggregation is attributed to Empedocles in regard to his elements in *Metaphysics* 984 A 9-11; the general distinction is attributed to all the pluralists in *Aëtius*, I, 24, 2. To suppose that Aristotle *here* took *φύσις* to mean "permanent nature" would deprive the citation of all appropriateness and the argument of all consequence besides nullifying his later criticism (314 B 13 ff.) which proceeds on the assumption that the possibility of a "permanent nature" is recognized by Empedocles and the pluralists. Cf. page 243, note 114 *infra*.

<sup>447</sup> *De Generatione* 314 B 8-26.



aimed at all pluralists, he quotes only Empedocles as evidence of the truth of his assertion and argues against him while implying that the some objections refute all the pluralists. Empedocles says that the sun (i. e. fire) is white and hot, the rain (i. e. water) dark and cold;<sup>448</sup> but if one element cannot arise from another, there can be no change from quality to quality, that is, no alteration. This is, of course, exactly what Empedocles himself would assert, since he and all the pluralists sought by their mechanism of mechanical mixture to explain away *both* generation *and* what Aristotle calls qualitative change.

But Aristotle has the further objection to Empedocles that he speaks part of the time as a monist and again as a pluralist,<sup>449</sup> for, though he says the elements cannot become one another, he does reduce them to the *Sphere* from which he again generates them; whence it is clear that the qualities are separable and that in a sense he is a monist, for he generates the elements by a change of quality from a single material substrate. Inasmuch, however, as this matter is the result of the combination of four bodies prior to it, he is a pluralist. This objection depends upon the misinterpretation of the *Sphere* which has been previously noted;<sup>450</sup> it is a result of Aristotle's constant tendency to interpret mechanical combination and segregation wherever the process occurs as a halting attempt at a theory of qualitative alteration and consequently to view all precosmical mixtures as an approach to his own potential matter. The nature of this potential matter, he believes, gives the correct solution to all the problems involved in the distinction between generation and alteration; and the inconsistencies of previous pluralistic theories result from the failure to under-

<sup>448</sup> Empedocles, *fragment* 21, lines 3 and 5. Aristotle has λευκόν instead of λαμπρόν and a transposition of words in line 3.

<sup>449</sup> *De Generatione* 315 A 3-25.

<sup>450</sup> Page 36, note 135; pages 50-51 *supra*, and cf. in the present passage Aristotle's brief argument to prove that the *Sphere* is an homogeneous compound and not merely a mechanical combination, 315 A 18-19: οὐ γὰρ δὴ πῦρ γε καὶ γῆ καὶ ὕδωρ ἔτι ὄντα ἐν ἡν τὸ πᾶν. (Shorey in *Class. Phil.*, XVII, p. 350 refers for retention of ἔτι to Plato, *Symposium*, 187 A. The argument of that passage is exactly parallel to Aristotle's argument here.)

stand the nature of this substrate. But that the pluralists not only must in consequence of their pluralism recognize an essential difference between the two processes but in fact do recognize such a difference Aristotle is convinced; and he feels sure that they identify generation with aggregation and alteration with an exchange of qualities,<sup>451</sup> although he has just proved that for Empedocles qualitative change and generation (i. e. aggregation) are necessarily the same process and has implied that this was true for all pluralists. Only Democritus, however, gave any more than superficial attention to the problems involved,<sup>452</sup> for, apart from saying that growth occurs when like approaches like (and they gave no explanation of *how* this occurs), no one gave any definite account of the processes of growth, combination, or interaction. But Democritus evidently pondered all the problems and that, too, in a distinguished fashion, for he and Leucippus explained genesis and destruction by the aggregation and dispersion of the atoms, alteration by their position and arrangement. This interpretation implies that the essential nature of a compound body is changed only by the introduction or withdrawal of the constituent atoms whereas the qualitative alterations in such a body are due to the realignments of atoms already present; in other words, Aristotle identifies the primary and secondary qualities with what he calls essential and accidental characteristics.<sup>453</sup> Elsewhere, however, he makes no such distinction,<sup>454</sup> and even here his next sentence confutes this interpretation. Since they thought that truth was involved in sensation, he says, and that appearances were infinite and contrary one to another, they posited an infinite number of atoms so that the same thing might appear different to different perceivers by reason of changes of composition and might *by a slight addition* be changed (μετακινεῖσθαι) and by the change of a single part appear completely different.<sup>455</sup> It is so that comedy and tragedy

<sup>451</sup> *De Generatione* 315 B 15-19.

<sup>452</sup> *De Generatione* 315 A 34-B 15.

<sup>453</sup> On this whole matter see Heidel, *op. cit.*, p. 373 and note 124.

<sup>454</sup> Cf. *De Generatione* 314 A 23-24; 315 B 33-316 A 1.

<sup>455</sup> Cf. Theophrastus, *De Sensibus*, 64-67; Simplicius, *Phys.*, 36, 1-7; Sim-



consist of the same elements, namely letters.<sup>456</sup> Aristotle has now attributed to the Atomists not merely the doctrine that aggregation is genesis but also the thesis that there is qualitative alteration which is a process different from genesis. He now intends to hold them to account for the implications that the terms *γένεσις* and *ἀλλοίωσις* bear in his own system. The question whether genesis is aggregation is introduced by the problem of indivisible magnitudes; and the theory of indivisible magnitudes exists in two forms, the Platonic doctrine of elementary planes and the Democritean doctrine of elementary atomic solids.<sup>457</sup> The latter is the more reasonable form;<sup>458</sup> although it presents much difficulty, it can account for genesis and alteration by the differences of the atoms and the change of position and arrangement of the same atom, which is in fact the procedure of Democritus that enables him to deny real existence to color since the coloration is due to the position.<sup>459</sup> The Platonists cannot derive qualities from their planes,

plicius, *De Caelo*, 295, 22-24: *εἰ τοίνυν ἡ μὲν γένεσις σύγκρισις τῶν ἀτόμων ἐστίν, ἡ δὲ φθορὰ διάκρισις καὶ κατὰ Δημόκριτον ἀλλοίωσις ἂν εἴη ἡ γένεσις*. The "change" expressed by *μετακινεῖσθαι* was to the Atomists a change of place; but, since it resulted in a change of secondary qualities, Aristotle felt justified in interpreting it as "alteration" in his own sense.

<sup>456</sup> The source of the example is not known; it may derive from the Atomists (cf. Diels, *Elementum*, pp. 13 f.), but Aristotle's words do not imply that it is a quotation.

<sup>457</sup> *De Generatione* 315 B 20-32.

<sup>458</sup> *De Generatione* 315 B 32-316 A 2; 316 A 5-14.

<sup>459</sup> See pages 111, note 454; 111, note 455. Theophrastus, *De Sensibus*, 64-68 illustrates how Democritus tried to explain flavors and colors by the forms of the atoms as does Aristotle briefly in *De Sensu* 442 B 10-12. Theophrastus, *De Sensibus*, 60 says *Δημόκριτος μὲν οὐχ ὁμοίως λέγει περὶ πάντων, ἀλλὰ τὰ μὲν τοῖς μεγέθεσι, τὰ δὲ τοῖς σχήμασιν, ἕνια δὲ τάξει καὶ θέσει διορίζει*. But in 69 a hint is given of the real method of Democritus: Theophrastus objects *ὅλως δὲ μέγιστον ἐναντίωμα καὶ κοινὸν ἐπὶ πάντων, ἅμα μὲν πάθη ποιεῖν τῆς αἰσθήσεως ἅμα δὲ τοῖς σχήμασι διορίζει*. This, in connection with 67: *ἔτι δὲ εἰς ὅποیان ἔξιν ἂν εἰσέλθῃ, διαφέρειν οὐκ ὀλίγον*, shows that Democritus meant to make the secondary qualities a resultant of the shape, position, arrangement (and size?) of the atoms of the perceived object (or effluence) on the one hand and of the condition of the percipient on the other. Carelessness or brevity of expression as well as occasional lapses from consistency in his exposition could easily give rise to confusion in the reports of his theory. It is just such an account of perception which is summarized by Plato, *Theaetetus* 182 B 1-7.

however, and do not try to do so. This remark gives Aristotle occasion to praise the concern of Democritus with "the facts of nature" and to disparage the abstract dialectics of the Academy. The refutation of the hypothesis of atomic bodies on which rests the Atomists' theory of genesis is introduced by a long dilemma concerning the divisibility and continuity of body in which it is shown that, if matter be supposed to be everywhere divisible, corporeal magnitude must consist of immaterial points.<sup>460</sup> For the difficulties involved in supposing the elements of matter to be indivisible reference is made to the *Physics*.<sup>461</sup> Although it is possible to conceive a body potentially divisible at every point and actually indivisible, it is impossible to suppose it even potentially divisible at every point simultaneously, for such a potency might be actualized, in which case one would have to admit that body was constituted of immaterial points.<sup>462</sup> With this introduction to the problem Aristotle outlines what he feels to be the reasoning which makes men think atomic bodies necessary;<sup>463</sup> he does not say that it was the reasoning that led the Atomists to their theory, and it is not mentioned in what purports to be the historical account of the origin of Atomism;<sup>464</sup> but it is consistent with Aristotle's praise of the Atomists for use of natural phenomena as evidence and in that respect agrees with his other account according to which Leucippus devised his theory to save the phenomena. It is evident, this argument runs, that bodies are

<sup>460</sup> *De Generatione* 316 A 14-B 16.

<sup>461</sup> *De Generatione* 316 B 16-18. The argument in *Physics* 231 A 21-B 18 runs: Nothing continuous can consist of indivisibles, as, for example, a line of points, for 1) points cannot be continuous, 2) they cannot be in contact except as coincident, in which case they would form no continuum, 3) they cannot be consecutive since between any two points there is a line and the intermediate cannot be of another genus (for this would be either divisible or indivisible). Every continuum then is divisible into divisibles; otherwise there would be contact of indivisibles.

<sup>462</sup> *De Generatione* 316 B 18-27.

<sup>463</sup> *De Generatione* 316 B 28-34. I. Hammer-Jensen (*Archiv für Geschichte der Philosophie*, XXIII [1910], pp. 103 ff. and 211 ff.) represents the argument of 316 A 14 ff. as that of Democritus himself.

<sup>464</sup> That is *De Generatione* 325 A 2-29. See page 95, note 401.



divided into smaller and smaller separate parts; and, since this process could not go on forever, there must be a limit to the divisibility of bodies. Therefore, there must exist atomic bodies below the range of vision, especially if genesis and destruction are to be explained as aggregation and dispersion. Admirable as this reasoning seems to be, however, it is really a paralogism,<sup>465</sup> Aristotle argues, for point cannot border on point since points are not consecutive or in contact. Hence, although body is divisible anywhere (for there is one point anywhere and all the points—taken singly—are everywhere), all the points in a given magnitude cannot be taken simultaneously (for they are not consecutive) and the body is not divisible everywhere in the sense of everywhere at once. Consequently, division and combination—and so segregation and aggregation—there is, but not of atoms nor by complete and simultaneous division; the material parts involved are only *relatively* small with respect to the body divided or composed.

The virtue of this argument consists in the fact that it seeks not merely to disprove the possibility of atomic bodies but at the same time to solve the difficulty which Aristotle supposes the invention of atoms was intended to meet.

It does not yet solve the specific problem, however, for, although the Atomists thought that atomic bodies were a necessary element in the explanation of genesis, Empedocles and Anaxagoras identified genesis and aggregation without the use of indivisible magnitudes. Aristotle, consequently, must turn directly to the fundamental question of the nature of generation and its distinction from alteration. And first he claims that the mistakes of the pluralists derive from their definitions of simple genesis and destruction as aggregation and dispersion and of alteration as change which takes place in a continuous body.<sup>466</sup> Besides not having made any distinction between the two processes, the pluralists obviously could not have founded such a difference upon the opposition of discrete and continuous bodies, for to the Atomists all alterable bodies were aggregates and both Anaxagoras and Empedocles,

<sup>465</sup> *De Generatione* 317 A 1-17.

<sup>466</sup> *De Generatione* 317 A 17-31.

although neither had defined the limits of contact, supposed that all bodies capable of change were in reality aggregates of other bodies which, though qualified, were incapable of alteration. The only basis for such an interpretation as Aristotle here introduces is the Atomistic theory that realignment of the constituent atoms without the addition or subtraction of any atoms may change the secondary characteristics of the compound body. This process as opposed to that in which atoms were added, subtracted, or replaced Aristotle tended, as has been shown, to identify with his own distinction between accidental and substantial change. It is but a short step, then, to interpret the first case as one of change in a *continuous* body (for no addition or subtraction of constituent parts has occurred) and to restrict segregation and aggregation to the second, although the two processes are essentially the same and neither body is in fact continuous.<sup>467</sup> Though the compound bodies of Anaxagoras and Empedocles might more plausibly be called continuous (although Aristotle elsewhere says they are really discretes in contact), all changes in them are clearly due to addition or subtraction, that is, aggregation and segregation. Consequently alteration, so-called, and genesis and destruction are different degrees of the same process which depends upon the discontinuity, however conceived, of all passible bodies.

It is, however, the change of a body as a whole into another body and not the process of segregation-aggregation which is simple or real genesis and destruction; and the pluralists consider this to be alteration because they overlook the distinction between the substantial and accidental characteristics of an object. Change in the substance, as a composite of matter and form, is generation or its opposite; change in the qualities, being accidental, inasmuch as it does not touch the substance of the thing, is alteration. Aristotle concedes, however, that aggregation and dissipation contribute to the rate at which genera-

<sup>467</sup> Heide, *op. cit.*, p. 374: "The most that can be said for his (Aristotle's) position is that Democritus . . . sometimes attributed a change to differences of position and arrangement without specifically mentioning the factor of recombination."



tion and destruction take place, for he believes that smaller quantities of water change into air more quickly than large quantities;<sup>468</sup> but he asserts that genesis itself cannot be aggregation as the pluralists say.

By absolute or real generation Aristotle does not mean "generation from nothing";<sup>469</sup> but between the absolutely real, which is pure actuality, and pure potentiality, which is final matter, the proximate materials of substances have varying degrees of reality.<sup>470</sup> Although the generation of one substance involves the simultaneous destruction of another, the change from a material of lesser reality to one of greater reality may plausibly be called genesis as opposed to change in the opposite direction;<sup>471</sup> but fundamentally each such change is both real generation and real destruction.<sup>472</sup>

The attempt to discover among his predecessors some recognition, however ambiguous and inadequate, of the distinction between generation and alteration is in keeping with Aristotle's usual method; once his interpretation has extracted such an admission he considers that presumptive evidence for the reality of the distinction in some sense has been established.<sup>473</sup> Still, his method of interpretation shows that he had previously presumed the results which he later succeeded in establishing;

<sup>468</sup> This principle Aristotle had to incorporate into his system since it seemed to rest upon ocular evidence of the nature of fire and water. Cf. the use made of it against Empedocles (*De Caelo* 305 A 6-14, page 59 *supra*).

<sup>469</sup> *De Generatione* 317 A 32-B 33. N.B. 317 B 29-31, the constant dread of "those who first philosophized" was lest generation should be supposed possible without a prior substrate.

<sup>470</sup> *De Generatione* 318 B 14-18.

<sup>471</sup> *De Generatione* 318 B 27-33 and the general axiom, 318 B 2-3, διαφέρει γὰρ εἰς ἂ μεταβάλλει τὸ μεταβάλλον.

<sup>472</sup> If, however, one were to posit two fundamental materials, one of which is Being and the other non-Being, change from the former to the latter would be "real destruction" and change in the other direction "real becoming." Parmenides, says Aristotle (*De Generatione* 318 B 3-12), does posit fire as Being and earth as non-Being. Consequently, for him "the road to fire" would be absolute becoming and relative destruction, and the genesis of earth would be relative becoming and absolute destruction. (On this attribution to Parmenides cf. page 48, note 192 *supra*.)

<sup>473</sup> *De Generatione* 315 B 15-19.

and an intelligent estimate of his final criticism of pluralistic theories of generation requires a brief examination of the basis on which his own theory rested. The only evidence which he adduces for the reality of genesis as distinct from alteration is the empirical fact that the simple primary bodies change into one another;<sup>474</sup> and the truth of his doctrine he explicitly stakes upon the ultimate reality of this fact.<sup>475</sup> Proof that this is real and necessary, again, is its consistency with his principle that generation is from contrary to contrary, for the primary bodies display qualitative contrariety in respect to one another.<sup>476</sup> Such a change of itself, however, does not suffice to explain why generation should be considered a process essentially different from alteration; and the specific differentia of generation, the imperceptibility of the substrate,<sup>477</sup> seems so artificial and arbitrary that one is forced to look elsewhere for Aristotle's original reason in making the distinction.<sup>478</sup> The doctrine is obviously just the dynamic aspect of the distinction between essential and accidental characteristics; and the explanatory examples of the two processes given by Aristotle himself show that the theory in his own mind rested upon the doctrine of the categories.<sup>479</sup> The vindication of substantial change as distinct from changes in the other categories has the purpose of maintaining the qualities as ultimate and preventing the degeneration of essence into mere relationship, which error Aristotle considered a necessary consequence of all previous theories except possibly those of Empedocles and Anaxagoras.<sup>480</sup>

<sup>474</sup> *De Caelo* 304 B 25-27, 305 A 31-32; *De Generatione* 329 B 22-24.

<sup>475</sup> *De Caelo* 298 B 9-11.

<sup>476</sup> *De Generatione* 331 A 12-23.

<sup>477</sup> *De Generatione* 319 B 6-21.

<sup>478</sup> Aristotle's definition leaves genesis and alteration quâ processes undistinguished. It is only the nature of the substrate in which the process occurs which determines whether or not genesis has taken place, for genesis is really alteration of prime matter.

<sup>479</sup> *De Generatione* 319 A 8-17. Absolute genesis and qualified genesis (i. e. alteration) are defined by the categories. In 319 B 24-320 A 2 the definitions are explained by an illustration which is essentially grammatical in its analysis.

<sup>480</sup> *De Caelo* 303 B 29-304 A 7. See pages 13 and 16 *supra*.

Genesis, then, for Aristotle is substantial change; and he criticizes the earlier pluralists on the supposition that their theories of separation and recombination, while designed to fulfil the requirements of such change, missed its essential characteristics.<sup>481</sup> Empedocles, Democritus, and their schools failed to discern that the separation of an element out of a mixture in which it previously existed is only apparent generation, for the "resultant" body is not the product of a material substrate nor has it undergone any change itself in the process. But there are, besides, definite impossibilities involved in this theory; it requires that a given quantity of matter be heavier when compressed, for the water which has been separated out from air is heavier than it was in the previous state. If, then, it existed as water in the air, it must have taken on weight in the process of separation. Aristotle's introduction of the notion of compression into the theories of Empedocles and Democritus is without foundation,<sup>482</sup> though the Atomists may have supposed that the atoms in water have less void separating them than those in air.<sup>483</sup> At any rate, Aristotle's objection has no validity, for it rests upon his theory that the smallest quantity of water imaginable is heavier than the largest quantity of air.

In the second place, mere separation of one element out of a mixture cannot explain why the element occupies more space after the separation than before. The vaporization of liquids, however, shows that this is the case. If, then, there is no void and no expansion of bodies,<sup>484</sup> this phenomenon cannot be explained on the theory of separation; and, if there is both,<sup>485</sup> it is unreasonable to suppose that the separation must precede the expansion.

<sup>481</sup> *De Caelo* 305 A 33-B 28.

<sup>482</sup> Aristotle elsewhere attributes the mechanism of condensation-rarefaction to the monists generally (*Physics* 187 A 12-16, *De Generatione* 330 B 9-12). See pages 50, note 201, and 55 *supra*.

<sup>483</sup> This is consistent with their reported explanation of the relative weight of composite bodies according to which the more void a body contains the lighter it is. Cf. *De Caelo* 309 A 6-11.

<sup>484</sup> The theory of Empedocles and Anaxagoras.

<sup>485</sup> The hypothesis of the Atomists. But expansion is to be understood only of complexes of atoms when "more void" is introduced into the interstices.

Lastly, such a theory does not allow the continual generation of the elements from one another unless one were to presume that a finite quantity can contain an infinite number of finite quantities, for each separation of water from a quantity of earth, for example, diminishes the original mass, and this process must come to an end unless the impossible supposition previously mentioned be made.<sup>486</sup>

The application of a single refutation to the systems of the Atomists, Anaxagoras, and Empedocles obscures the differences of the various theories<sup>487</sup> and Aristotle's habit of thus treating his predecessors in groups has seriously mutilated the doxographical tradition. All three systems are obnoxious to the objections involved in the general theory of aggregation and dissipation as such; but special difficulties of Empedocles' methods, for example, cannot be treated as though they were also inherent in the Atomic theory. Yet this is what Aristotle does. Partly, perhaps, because he has equated the changes due to position and arrangement of atoms with qualitative alteration, that is accidental change, he confines the change from element to element to the segregation of particles from a mixture; and even here he overlooks the fact that for the Atomists segregation would be only part of the process of which the moment of recomposition is at least an equally important part. From such critiques, then, it is impossible to reconstruct a fair account of the Atomistic explanation of the formation of one body from the atoms of another, for Aristotle nowhere does justice to various possibilities of mechanism which the theory of atoms and their primary characteristics offered nor does he give any exact information as to how the Atomists themselves employed these possibilities. Moreover he is inclined to iden-

<sup>486</sup> Simplicius takes the third argument to be meant for Anaxagoras. It is used against him in *Physics* 187 B 22-188 A 2 (page 51 *supra*); but it is applied to the Atomists in *De Caelo* 303 A 25-29 (page 6 *supra*). There is a difference of emphasis in these passages, since in the two just cited Aristotle is arguing against the nature of the elements proposed while in the present passage he is refuting the method of generation; but the third part of the present passage like the first two is aimed at the pluralists in general and Empedocles and Democritus in particular.

<sup>487</sup> See page 6 *supra*.



tify the masses of the four so-called elements with specific atoms, misled perhaps by the carelessness of Democritus himself in specifying the atoms of fire as round. This same ambiguity intrudes itself into his treatment of Empedocles, for he constantly argues as though the elementary air of Empedocles were the same as the atmospheric air of our experience, an interpretation which is no more probably true for Empedocles<sup>488</sup> than it is for Anaxagoras in the case of whom Aristotle is similarly confused.<sup>489</sup> Finally, his objection that the world process could not be continuous on any of these three theories is no more cogent than is the same objection to his doctrine of natural motions. He himself has said that were that principle of his to operate alone and unimpeded all the primary bodies would instantly be segregated and no further change could occur. But there is constant interaction at the boundaries of any two regions which results in large zones in which no body exists in a pure state.<sup>490</sup> Just so in this world free atoms or complexes of atoms are coming into contact with other such masses, free bits of Empedocles' pure elements as soon as they are released from combination are again mixed with other fragments, and for Anaxagoras no seed exists actually unmixed with others, so that clearly this objection will not stand for the state of the world as it is.

The close external resemblance of the theory of Empedocles

<sup>488</sup> Cf. Heidel, *op. cit.*, p. 366; Aëtius, II, 7, 6; and Achilles, *Isag.* (*Fragmente der Vorsokratiker*, § 21 A 35).

<sup>489</sup> Cf. *De Generatione* 314 A 29 f., where earth, fire, water, air are called each a *πανσπερμία*, with *De Caelo* 302 B 1, where only air and fire are called mixtures of all the seeds. Joachim on the former passage says that earth is rather on the level of simplicity of the seeds and refers to Anaxagoras, *frag.* 4. But Joachim fails to appreciate the fact that the seed, earth, is different from the earth which is a compound body and so does not see that Aristotle wavers because he overlooks the difference in Anaxagoras exactly as he does in Empedocles. As a consequence Aristotle discovers inconsistencies which are not really present in these theories.

<sup>490</sup> *De Generatione* 337 A 7-15. The explanation is given as a substitute for that of Plato (*Timaeus* 58 B-C); the problem itself was stated in *Timaeus* 58 A and it is to that passage that *οτινες απορρυσιν* of 337 A 8 refers (Shorey, *Class. Phil.*, XVII, p. 352).

to his own evidently both attracted and piqued Aristotle. The four "eternal roots" of the older theory seemed even more like his "primary bodies" since he was inclined to treat the *Sphere* from which they were separated out as an analogue to his own prime matter, the substrate of those bodies. Consequently he is eager to show not only that these four roots must change into one another but also that the language of Empedocles implies that they do so,<sup>491</sup> for he calls them all "equal."<sup>492</sup> Aristotle maintains that only if they are capable of changing into one another are they comparable, for two things that are quantitatively comparable must have some one common substrate by which they are measured. If they are comparable only in respect of their potencies they may be analogous, but in that case the correspondence is one of similarity and not of equality; and, if the potencies of two elements are quantitatively proportionate, the substrate of measurement must be one and the same. It is therefore absurd to say that unchangeable bodies are comparable by measurement of their potencies, for example that so much fire and so many times as much air are equally hot, for such a proportion is possible only in consequence of a basic homogeneity of the two bodies.<sup>493</sup> Just as in his treatment of the *Sphere*, Aristotle here tries to

<sup>491</sup> *De Generatione* 333 A 16-34.

<sup>492</sup> The words are quoted from Empedocles, *frag.* 17, line 27.

<sup>493</sup> The point of 333 A 33-34 is that only greater and lesser amounts of the same thing can be comparable in such a fashion and that they are comparable just because they are of the same kind. So in *Meteorology* 340 A 11-17, arguing that the potency of any element must vary directly with its quantity so that all the air in the universe must stand to all the water as does any quantity of air to the quantity of water that has changed into that air, he meets an objection which might be made on the basis of Empedocles' theory by saying that, even if one were to claim that the elements do not arise from one another but are, nevertheless, equal in potency, still their equality of potency must be a function of their quantity (*ἀνάγκη τὴν ἰσότητα τῆς δυνάμεως ὑπάρχειν τοῖς μεγέθεσιν αὐτῶν*). The basic homogeneity which affords a means of quantitative comparison of the two bodies or their potencies is, in the last analysis, their common substrate; if one assumes such a comparison of the prime bodies, Aristotle feels that assumption to be tantamount to admitting the necessity of his primary matter.

find in Empedocles' words the implication of a common substrate for the four roots, assuming that such a substrate of which the simple bodies are merely various manifestations would be the material cause of their generation, in which case they would not be immutable.<sup>494</sup>

The establishment of this principle affords Aristotle an argument against the most varied doctrines of earlier philosophers. Since generation occurs between contraries and the contrariety of body to body consists in the relationship between the pairs of qualities which by informing prime matter constitute each of the four prime bodies, any one of these bodies can become any other, although the speed of transmutation is greater in certain cases than in others.<sup>495</sup> This precludes the possibility that any one of the four bodies or any other such tangible body apart from these four may be the material substrate out of which they are generated and proves that in the world of becoming the only simple perceptible bodies are these four.<sup>496</sup> The traditional sequence of the simple bodies in the universe was accepted by Aristotle, but the position of any one of them, in his system, does not influence the readiness with which it changes into any other. That depends upon the presence or absence of a common quality in the two bodies, so that earth changes more readily into fire than into air,<sup>497</sup> although the zone of air is nearer to that of earth than fire is. Consequently the readiest mode of transmutation is cyclical and not, as the material monists had assumed, oscillatory. For those who describe the change as starting from one of the extremes, earth

<sup>494</sup> In the Oxford translation of *Meteorology* 340 A 17 there is the remark that according to Aristotle's argument in *De Generatione* gold and lead, since they can both be weighed, must both be transmutable. Aristotle's argument refers specifically to the primary bodies, of course; but, inasmuch as all the material in the sublunary world is either one primary body or a compound of several of them, all material objects are transmutable, though the transmutation is not direct.

<sup>495</sup> *De Generatione* B, chap. 4. See Gilbert, *Meteorologische Theorien des Griechischen Altertums*, pp. 186-188.

<sup>496</sup> *De Generatione* 332 A 4-27. See pages 57-58 *supra*.

<sup>497</sup> *De Generatione* 331 A 36-B 9. Earth is cold and dry; fire is warm and dry; air is warm and moist.

or fire,<sup>498</sup> have to maintain that all the simple bodies are essentially this one extreme body in various phases; and this amounts to saying that everything consists of fire or earth.<sup>499</sup> The theory that the simple bodies are developed by change of one body intermediate in the series, that air, for example, changes in one direction to fire and in the other to water and water again to earth or back to air, but that the extremes do not change into each other is no more possible than the first theory.<sup>500</sup> The first refutation<sup>501</sup> assumes that each "element" has two and

<sup>498</sup> *De Generatione* 332 B 5-9. As Heraclitus did in the case of fire. No one, presumably, so used earth; but the refutation would hold in either case and earth is included to generalize the argument (cf., however, page 229, note 50 *infra*).

<sup>499</sup> This has been proved impossible. Cf. *De Generatione* 332 A 6-20 (page 58 *supra*) and *Physics* 205 A 1-7 (pages 28 ff. *supra*). This conclusion, as Joachim says (*op. cit.*, p. 227), is an equally cogent argument against all monists; Aristotle, in fact, in the passage of the *Physics* cited above uses it against them all. But here the *process* of change occupies his interest, and the process of derivation from a "middle element" seems to be essentially different in that it consists of two parts presumably unrelated except in so far as they both proceed from and return to a single starting-point. The consecutiveness of the process from one extreme seems to be lacking in that which proceeds in either direction from an intermediate point, and the "elements" developed on either side of the process seem to have no relationship with those developed on the other side.

<sup>500</sup> *De Generatione* 332 B 10-333 A 15. Joachim (*op. cit.*, p. 227) says that the theory here outlined and opposed is otherwise unknown. But it is, I think, meant to be that of Anaximenes (cf. Gilbert, *op. cit.*, p. 60; p. 45, n. 1; *Doxog. Graeci*, p. 278 [Aëtius, I, 3, 4]). Joachim argues that the theory denies the transformation of fire into air and earth into water, for otherwise it could not have regarded the middle element as an *ἀρχή* and would have admitted an indirect transformation of fire and earth into each other. But those who made one of the extremes the starting-point did not deny a return of the subsidiary forms to fire; that is clear from Heraclitus. Moreover an *indirect* transformation of earth into fire would not satisfy Aristotle whose cyclical theory demands that such a change be *direct* (cf. Gilbert, *op. cit.*, p. 188); at the same time, according to Aristotle's feeling a retransformation of fire into air on the one side and of earth to air on the other is not a transformation of the extremes into each other at all. The distinction, as Aristotle sees it, between the two theories here outlined is that the first assumes a single oscillatory change, the second a double one.

<sup>501</sup> *De Generatione* 332 B 14-30.



only two qualities, each of which is one term of a contrariety, and that two bodies, each possessing one complementary term of the same contrariety, must be transmutable. On this assumption, if air (A B) changes to water (A B') and to fire (A' B), water and fire, having a double contrariety, are transmutable into each other. Moreover there will be a fourth combination of these contraries, A' B', i. e. earth; and every combination, having a single or double contrariety with every other, will be capable of changing into any other. Next Aristotle tries to show that, if one seeks to avoid this result by supposing that instead of a closed series there may be infinite change in a straight line in either direction from an original body, one must assume that such a body has an infinite number of qualities each of which is one term of a contrariety.<sup>502</sup> The body which is the result of a process of change, if it is to change into another body not in the preceding series, must do so in virtue of a quality not the contrary of any quality in the states already passed through, the next change must occur in virtue of another such quality, and so on *ad infinitum*. The result is that one must suppose an infinite number of qualities to be present in any one "element." Such a body cannot be defined and cannot exist; and, since some "elements" could be generated only after an infinite number of changes, they would never come to be; in fact fire itself could not arise from air, for fire must have an infinite number of qualities too.

Further, Aristotle argues, all the "elements" would be one and the same, for the bodies below fire would have all the qualities of those above it and *vice versa*. This argument considers only one side of the double development from the intermediate element, air, and, further, treats two bodies which have qualities contrary to each other as if they had the *same* quality.<sup>503</sup> It is noteworthy that Aristotle himself says that his refutation holds only if there is no reverse change in the direction

<sup>502</sup> *De Generatione* 332 B 12-14. Here Aristotle states the thesis but first proves that in a limited series all the bodies are capable of changing into one another and returns to the original thesis at 332 B 30-333 A 15.

<sup>503</sup> Joachim (*op. cit.*, p. 230) remarks that Aristotle posits the same two contraries for all four of his primary bodies, yet no two of these bodies are for

of the original intermediate element<sup>504</sup> or cyclical change, and yet in his own account of the theory he attacks there is one case of reversion specified, the change of water into air.<sup>505</sup> The extreme elements do not change into each other, he says; but does that mean they do not change back to air and water respectively? Aristotle nowhere mentions a theory which made fire and earth immutable while positing air as the true element; and it is unthinkable that he (and all our other sources) should have passed by such an outlandish doctrine in silence, if it ever existed. But even if there was such a doctrine, why should he spend such a complicated refutation on it and say no word against the important theory of Anaximenes? It is impossible not to conclude that this is the doctrine of Anaximenes and that Aristotle has failed to meet its conditions in his refutation; and he could not have met them, for his own theory allows the reverse changes of fire to air and of earth to water to air, just as does that of Anaximenes. It is the direct change of the end elements, earth and fire, into each other which distinguishes Aristotle's method from that of his predecessors. This necessary link in the cyclical method depends upon the description of the four simple bodies as consisting each of two different terms of a set of two contraries; and it has been seen that Aristotle's argument against the theory that fire and earth cannot change into each other requires this assumption. In addition, it assumes that the phases of the changing "element" were the result of qualitative alteration along with all the corollaries implied by that terminology in the Aristotelian system, so that the theories refuted resemble the Presocratic doctrines they purport to represent only in the most superficial externals.

that reason the same. The fallacy of Aristotle's argument is to be seen from the following table:

Z		A' B' C' D . . .
X		A' B' C D . . .
Fire		A' B C D . . .
Air	—:Qualities:—	A B C D . . .
Water		A B' C D . . .
Earth		A B' C' D . . .
Ω		A B' C' D' . . .

<sup>504</sup> *De Generatione* 332 B 33: *ei γὰρ . . . eis ἄλλο μεταβαλεῖ καὶ μὴ ἀνακάμψει.*

<sup>505</sup> *De Generatione* 332 B 11.

From the fact that all four simple bodies change into one another Aristotle draws additional support for his theory of a fifth essence, the immutable substance of the heavenly bodies. The constituent element of the celestial sphere could not be subject to change, it is elsewhere demonstrated,<sup>506</sup> because change is possible for a body only in consequence of the contrariety of which it partakes. This contrariety of the four simple bodies is manifested by their natural motions which are contrary to one another; but the natural motion of the heavenly bodies, being circular, has no contrary, from which it follows that the essential qualities of those bodies are without contraries. The heavenly bodies and the sphere in which they move are, therefore, exempt from all change. The traditional name of this substance, αἰθήρ, Aristotle takes to be a confirmation of his theory,<sup>507</sup> supposing that the name was applied to it in ages past when the divinity of its nature was recognized; and he upbraids Anaxagoras for having used the word as synonymous with fire which he took to be the substance of the heavenly region. The reciprocal generation and destruction of the four simple bodies, taken in conjunction with the doctrine of the eternity of the world, requires a constant equilibrium of forces among the changing bodies, lest one of them swallow up the others.<sup>508</sup> Those people who think that the heavenly bodies and the sphere in which they move are pure fire and that the region between the earth and celestial sphere is air<sup>509</sup> do not take into account the real size of the stars and their true

<sup>506</sup> *De Caelo* 269 B 18-270 B 25.

<sup>507</sup> *Meteorology* 339 B 16-30. αἰθήρ he derives from the roots ἀεῖ and θεῖν. The same etymology and objection to Anaxagoras appear in *De Caelo* 270 B 16-25 (cf. *De Caelo* 302 B 4); and in both passages Aristotle states his belief in the infinite recurrence of the same opinions throughout the history of the world.

<sup>508</sup> See *Physics* 204 B 13-14 (see page 27 *supra*). In any given quantity of two elements it is the preponderance of the active quality in one or the other which causes the change (cf. *De Generatione* 334 B 20-25).

<sup>509</sup> *Meteorology* 339 B 30-340 A 18. In *De Caelo* 289 A 16-19 Aristotle says that those who made the stars of fire did so because they thought the heavens were fiery, since they thought it reasonable for everything to consist of that substance in which it exists. In the present passage he has Anaxagoras chiefly in mind, although he probably feels that the statement applies to all the Presocratics and Plato as well. Cf. page 184, note 171 *infra*.

distance from the earth.<sup>510</sup> If the stars and their environment were of fire, the amount of fire would be so preponderant as to have destroyed the other "elements" long ago; and, if this sphere and the region between it and the earth consisted of fire and air, even so the equilibrium of the four "elements" would be upset, for the region of earth and water is as nothing in comparison with the size of the surrounding universe. Besides, when water turns to air or air to fire, we see that there is no such discrepancy in the quantities of the original body and the new one, and the proportion of the air resulting from a given quantity of water to that water must be the same as that of all the air in the universe to all the water. Hence the heavenly bodies and the space between them must consist of some material other than the four "elements" of this world and incapable of interacting with them.

The objections Aristotle brings to previous meteorological theories are all ultimately based upon the assumption of such a generation and destruction of these four bodies. That no previous theory took this interaction into account was enough to invalidate any and all of them, for meteorological phenomena are in his system manifestations of the genesis and destruction of the simple bodies. The nature of winds and the origin of terrestrial waters are crucial points in the deviation of his system from all previous explanations; and his treatment of these two problems he combines, evidently because the predominant solutions of both were at variance with a single principle of his own system. In discussing the two problems, moreover, his attention is directed in each case against a single theory the authors or advocates of which he does not name, so that it is probable that these were the two predominant explanations of his own day. Their origins, however, are demonstrably Presocratic.

There are some, he says, who say that wind is simply air in motion and that this same air when condensed becomes cloud and then water.<sup>511</sup> For them water and wind are a single material element and all winds are one and the same, as they say,

<sup>510</sup> See *De Caelo* 298 A 6-20.

<sup>511</sup> *Meteorology* 349 A 16-30.



their apparent differences being due only to the regions from which they blow. This is much the same as the notion that all rivers are really one. The view here given agrees with that elsewhere attributed to Anaximenes;<sup>512</sup> but, though Anaximander and Heraclitus seem not to have generated wind by a condensation of air, it is true that for them, also, wind and rain seem to have been essentially of one nature.<sup>513</sup> It is certain, however, that neither Empedocles nor Anaxagoras could have made wind and water variations of the same material substrate; for the latter wind may have had a peculiar nature as well as being movement, but for Empedocles it could have been nothing but atmospheric air in motion.<sup>514</sup> Still it is possible that Aristotle thought they, too, were committed to this theory, since we have passages from both writers which superficially appear to connect wind and rain.<sup>515</sup> At any rate, he represents the theory that wind is merely air in motion, which was the predominant view among the later Presocratics,<sup>516</sup> as necessarily involving the thesis that clouds and rain are compressed air, a theory which was held only by Anaximenes.

The atmosphere of the earth, according to Aristotle, consists of two exhalations which are the intermediate stages, the one between earth and fire, the other between water and air;<sup>517</sup> the moist exhalation, which is water in the process of changing into air, is the material source of rain, and the dry exhalation, which is earth in the midst of becoming fire, is the material principle of wind.<sup>518</sup> This is enough to prove to Aristotle's satisfaction that rain and wind are essentially different;<sup>519</sup> but, fur-

<sup>512</sup> *Doxog. Graeci*, p. 477, 2-5; Hippolytus, *Refut.*, I, 7, 7.

<sup>513</sup> Anaximander: Aëtius, III, 7, 1; Heraclitus: Diogenes Laërtius, IX, 10.

<sup>514</sup> See Gilbert, *op. cit.*, p. 519, p. 520.

<sup>515</sup> Anaxagoras, *frag.* 19; Empedocles, *frag.* 50.

<sup>516</sup> Empedocles, the Atomists, Hippocrates and his school all held this view, though the cause of the motion was vaguely and variously given (Gilbert, *op. cit.*, pp. 519-522).

<sup>517</sup> *Meteorology* 341 B 6-22; 340 B 14-29.

<sup>518</sup> *Meteorology* 359 B 27-360 A 17.

<sup>519</sup> *Meteorology* 360 A 17-33. Olympiodorus and Alexander take the argument to be aimed at Hippocrates; Gilbert, *op. cit.*, p. 523, n. 2, more correctly says that it is "die ganze ältere Lehre, wie sie durch Anaximander begründet

ther, he insists that it is absurd to call air in motion, whatever its source, wind. As water in motion is not considered to be a river unless it flows from a definite source, so a wind cannot reasonably be air moving in any indefinite fashion but only something which has motion from a single, well defined origin. Gilbert<sup>520</sup> has noted that Aristotle's definition of wind as movement of the dry exhalation is not materially different from the older definition of it as air in motion, inasmuch as the dry exhalation is a portion of the atmosphere, but that he performed a real service in furnishing a definite efficient cause for the motion. It seems rather more appropriate to notice, however, that Aristotle's criticism was distinctly reactionary in attributing a special material nature to wind which makes that phenomenon dependent upon an alteration in the material substrate. It is a serious mistake to suppose that Aristotle's theory is a forerunner of the explanation of air currents on the basis of thermal changes of the earth's surface; the action of the heat—whether of the sun or of that within the earth itself<sup>521</sup>—is productive of wind only secondarily in that it causes the generation of the dry exhalation by the destruction of earth as such.

With this theory of wind Aristotle connects the so-called meteorological theory of terrestrial water and opposes it on the same grounds. This theory, according to his account,<sup>522</sup> supposes that the water drawn up by the sun falls again as rain, is collected below the earth, and flows out of subterranean reservoirs, of which each river has a separate one or a common one serves for all rivers. This is the source of all water and explains why rivers are fuller in winter than in summer and also why some flow the year round while others do not, the former being those of which the reservoirs are large enough to collect a supply of water to last through the dry season.<sup>523</sup>

ist" that Aristotle criticizes. But the criticism does not apply as such to Empedocles, the Atomists, et al.; against them Aristotle should have urged the insufficiency of their *origin* of motion for the winds (cf. page 246, note 118 *infra*).

<sup>520</sup> *Op. cit.*, pp. 533-534.

<sup>521</sup> *Meteorology* 360 B 30-32.

<sup>522</sup> *Meteorology* 349 B 2-15.

<sup>523</sup> Definite citations of this theory for the Presocratics are unfortunately lack-



The only direct objection which Aristotle can bring against this explanation is that the earth is not large enough to contain a reservoir of all the water which flows during the dry season;<sup>524</sup> but the real absurdity of it, to his mind, is its failure to generalize the change of air into water as it presents itself to the senses in our atmosphere. This generation of water from air under the influence of cold must occur constantly in the earth just as it does above it;<sup>525</sup> and this fact itself precludes the assumption of subterranean reservoirs as the ultimate source of rivers and springs. The change from air to water must occur in the form of tiny drops beneath the earth as we see that it does above it; the drops run together until they appear as water-masses of various size on the surface of the earth. The method in which water seeps through the earth into ditches is adduced as evidence of the truth of this view as well as the observation that rivers rise in mountainous districts, for the mountains are taken to be porous, in consequence of which they become saturated with rainwater (for Aristotle does not deny that *part* of the terrestrial water has this origin) and at the same time allowing the moist exhalation to rise through them they reduce it to water by cooling. As the earth is not large enough to store sufficient water for the nourishment of streams and rivers, so the clouds cannot furnish enough rain to account for the constant flow of water on the earth's surface; for Aristotle the quantity of this flowing water can be accounted for only by the supposition of a constant generation of new water within the earth itself.<sup>526</sup>

ing. Hippolytus, *Refut.*, I, 8, 5 establishes it certainly for Anaxagoras, *Refut.*, I, 6, 7 probably for Anaximander, and Aristotle, *Meteorology* 365 B 1-6 implies it for Democritus. Gilbert, *op. cit.*, pp. 403-414 tries to establish it as the common doctrine of Xenophanes, Anaximander, Empedocles, Anaxagoras, Diogenes, Democritus, and the Academy.

<sup>524</sup> *Meteorology* 349 B 15-19.

<sup>525</sup> *Meteorology* 349 B 21-350 A 16. The axiom of the meteorological theory which Aristotle stresses as its fundamental error is *καὶ οὐ γίγνεσθαι ὕδωρ οὐδέν* (349 B 5).

<sup>526</sup> *Meteorology* 350 B 22-30. Cf. *Meteorology* 352 B 4-11, where he explains that whether a river flows the year round or not depends on the size and porosity of the high places where it rises and not, as some say, on the size of the underground reservoirs.

The critique of previous theories concerning the origin and nature of the sea also depends upon the theory of exhalations, that is the generation of the simple bodies from one another. There are first outlined three early notions of the sea's origin,<sup>527</sup> the theory that there are springs or sources of the sea,<sup>528</sup> the explanation that the sea is the remainder of the original liquid state of the earth reduced to its present condition by evaporation due to the sun's heat, a process still going on and destined finally to desiccate the whole earth,<sup>529</sup> and the doctrine according to which the sea is a sweating of the earth when heated by the sun. To the partisans of the last theory the salinity of the sea seemed to be supporting evidence for their analogy.<sup>530</sup> This mention of salinity prompts Aristotle to speak of another theory which explained the sea's saltiness by supposing that there is present in the sea water a mixture of alkaline earth.<sup>531</sup>

<sup>527</sup> *Meteorology* 353 A 34-B 16.

<sup>528</sup> The words suggest Hesiod, *Theogon.*, 727-8, 736-8. But the further statement that the rest of the universe was "constructed about the sea and because of it" shows that Aristotle meant to include the theory of Thales (cf. Gilbert, *op. cit.*, p. 400, n. 1).

<sup>529</sup> The result of this evaporation produces the winds and the "turnings" of sun and moon. Theophrastus ascribed this theory to Anaximander and Diogenes (*Doxog. Graeci*, pp. 494-5). The same theory is outlined later, *Meteorology* 355 A 21-25, with greater exactness, for the action of the sun produces first *air* from the moisture and wind arises from this air. The "turnings" of sun and moon are due to the air (cf. Gilbert, *op. cit.*, p. 514, n. 1; Heath, *Aristarchus*, pp. 32 ff.). Democritus, too, assumed an ultimate complete evaporation of the sea (*Meteorology* 356 B 9-11); but his account of the origin of the sea assumed no original liquid condition of the earth (cf. Aëtius, I, 4, 4 and Diels, *Frag. der Vorsok.* 55 A 99<sup>a</sup>, II, p. 34, 33 ff.).

<sup>530</sup> Empedocles called the sea the sweat of the earth, cf. *Meteorology* 357 A 24-26; the mechanism by which the sea was produced was expression of the particles of water from the earth by reason of the compression of the earth under the sun's heat (Aëtius, III, 16, 3). Antiphon also identified the sea with sweat (*frag.* 32, Diels).

<sup>531</sup> The example which Aristotle himself quotes (*καθάπερ γὰρ τὸ διὰ τῆς τέφρας ἡθούμενον ἀλμυρὸν γίνεται, τὸν αὐτὸν τρόπον καὶ ταύτην ἀλμυρὰν εἶναι . . .*) implies that the alkaline infusion resulted from a filtration of the water through the earth. This was the explanation of Anaxagoras, Metrodorus, and Xenophanes (*Doxog. Graeci*, p. 495, 6-11; p. 565, 30; p. 566, 1); the mechanism of this filtration was not the same for all three, however (cf. Gilbert, *op. cit.*, p. 408, n. 1.).



This classification falls into two parts, the theory which posited sources of the sea and the others, all of which supposed the sea to be generated.<sup>532</sup> But while it was to be expected that the latter would be classified according to the method they used to generate the sea, Aristotle is diverted by the mention of salinity and in trying to give two classifications succeeds in giving neither.<sup>533</sup>

That there can be no special fountains of the sea Aristotle proves by two arguments.<sup>534</sup> Since waters which proceed from fountains are either flowing or, if standing waters, artificial and the sea is natural but has no natural course of flow, the sea cannot be the outflow of special fountains. Secondly, since the Caspian sea, for example, is a separate body of water the boundaries of which are known, the fountains of this sea, had there been any, could not have escaped discovery.<sup>535</sup> It is this same school of thought that conceived the sea as the ἀρχή of all water;<sup>536</sup> the reason for this ancient doctrine as reconstructed

<sup>532</sup> οἱ δὲ σοφώτεροι τὴν ἀνθρωπίνην σοφίαν (353 B 5) includes the partisans of the following two (or three) theories. Cf. ἔνιοι δ' αὐτῶν (line 11) . . . οἱ δὲ (line 13).

<sup>533</sup> E. g. although Democritus and Anaximander belong in the first part of this subdivision so far as they both assumed a final evaporation of the sea, their explanations of its origin and salinity were different. Empedocles and Anaxagoras used the same type of explanation of the origin and salinity, and Metrodorus was essentially in agreement with them; but Aristotle seems to think Empedocles' metaphor cannot mean merely a mixture of water and saline material (cf. 357 A 26-29). The explanation of salinity as due to the alkaline mixture brought down by rivers (*Meteorology* 357 A 15-18) is not here distinguished from that which attributed it to a permanent condition of the sea water as distinct from the inflowing river water. If the last subdivision be taken as equivalent to 357 A 15-18 (the theory of Xenophanes, cf. Gilbert, *op. cit.*, pp. 403-4), there is no place for Anaxagoras in the present classification, since Aristotle cannot have meant to include him in the subdivision at 353 B 11-13.

<sup>534</sup> *Meteorology* 353 B 17-354 A 5.

<sup>535</sup> Since there is an apparent direction of flow in the Mediterranean, Aristotle explains that this is due to the influx of rivers and to the varying depth of the sea's basin and is no evidence for the existence of special fountains of the sea (354 A 5-34).

<sup>536</sup> The words of 354 B 1, περὶ δὲ τῆς γενέσεως αὐτῆς, εἰ γέγονε, . . . and the following, τὴν θάλατταν ἀρχὴν εἶναι καὶ σῶμα τοῦ παντὸς ὕδατος (cf. 354 B 15-16), show that Aristotle is about to consider first a theory which held the sea

by Aristotle is anachronistic,<sup>537</sup> for he supposes it was prompted by the feeling that water *like the other elements* must have as its primary state a large continuous body, a condition satisfied for moisture only by the sea. Once the sea was thought to be the ἀρχή of all moisture, it was necessary for this school to suppose that rivers flow not only into it but also take their rise from it.<sup>538</sup> The sweetness of the river water which was supposed to flow out of the salt sea was explained by saying that in filtering through the earth the salt water becomes sweet. To this Aristotle first objects that it makes water *naturally* saline, since the ἀρχή of water is salty.<sup>539</sup> But since his final criticism of the theory depends on his own explanation of the salinity of the sea, he turns first to say that the movement of the sun, in its influence on the generation and destruction of the four "elements," causes the lightest and sweetest water to rise in the form of moist exhalation and again, as it cools, to change to water and fall upon the earth.<sup>540</sup>

This is the occasion for another digression, for his explanation invalidates the theory of certain thinkers according to which the sun is nourished by moisture.<sup>541</sup> This moisture, ris-

to be ungenerated. Such a notion fits the school of Thales and Hippo only; and it is fitting that Aristotle should consider this doctrine first (cf. 353 B 4-5, page 131, note 528 *supra*). Moreover, 354 B 16-18 shows that it was this same school that believed the rivers to flow *out* of the sea (cf. Hippo, 26 B 1, Diels). Consequently it is not the theory of Xenophanes which Aristotle here has in mind (cf. Gilbert, *op. cit.*, pp. 403-404).

<sup>537</sup> *Meteorology* 354 B 2-16.

<sup>538</sup> *Meteorology* 354 B 16-21.

<sup>539</sup> This criticism insures the interpretation that it is not Xenophanes against whom Aristotle is arguing, for Xenophanes accounted for the salinity of the sea (Hippolytus, *Refut.*, I, 14, 4) whereas Aristotle objects that the present theory accepts the salinity of sea water without explanation as if it were the original nature of water.

<sup>540</sup> *Meteorology* 354 B 21-33.

<sup>541</sup> *Meteorology* 354 B 33-355 A 21. This has usually been taken to be the theory of many Presocratics, but various definite limitations in Aristotle's account show that he has here only Heraclitus and his followers in mind. These are 1) the direct mention of Heraclitus for the purpose of turning his own statement against him (355 A 13-15), 2) the nourishment of the sun by *moisture* (354 B 34), 3) the explanation of the "turnings" of the sun from solstice to solstice

videtur Heraclitus II 24-25!



ing from the earth, somehow fed the fire of the sun which as it exhausted the nutriment in one portion of the sky moved on to another and so produced the phenomenon of the seasons, i. e., movement between the tropics. This theory, Aristotle says, was constructed on the analogy of the apparent conditions of ordinary combustion, for fire lives only so long as it has food and the nutriment of fire seems to be moisture, while the "upward path" of the moisture to the sun is analogous to the rising of the material which is changing into flame.<sup>542</sup> Aristotle first attacks the principle of the analogy by saying that the flame of fire is not nourished but is constantly being generated by a real elemental change; but the sun cannot be the same as such a flame, for there would in that case be a new sun not merely every day, as Heraclitus says, but every instant. Besides, if a fire is not nourished by the water it causes to evaporate, there is no reason to think that the sun, because it vaporizes water, is therefore nourished by the vapor. Finally, it is unreasonable to be concerned about the nourishment of the sun and to overlook the maintenance of the stars.<sup>543</sup>

as due to the exhaustion of the moisture by the sun (355 A 1-5; cf. Pseudo-Hippocrates, *περὶ διαίτης*, I, 3), 4) the phrase *τὴν ἀνοδὸν . . . τῇ γιγνομένῃ φλογί* (355 A 6-7), 5) the implication that the theory in question distinctly called the process *τροφή* and not *γένεσις* (355 A 9-11).

<sup>542</sup> For Heraclitean passages concerned with this process see Aëtius, II, 17, 4; II, 28, 6; Pseudo-Hippocrates, *περὶ διαίτης* I, 3; [Aristotle], *Problem.* 934 B 33 ff.; Diog. Laertius, IX, 9. Such passages as Hippolytus, *Refut.*, I, 7, 5 (Anaximenes) refer to the original composition of the heavenly bodies, not to their maintenance by moist exhalations (*ibid.*, I, 7, 7 proves affirmatively that Anaximenes did not think the sun or stars were "nourished" at all; cf. Aëtius, II, 14, 3). Xenophanes' theory has no connection with that outlined by Aristotle either (cf. *Doxog. Graeci*, p. 580, 13; Hippolytus, *Refut.*, I, 14, 3). Antiphon's doctrine, however, is very similar to that of Heraclitus and was probably adapted from it (cf. Aëtius, II, 20, 15).

<sup>543</sup> Heraclitus seems to have endowed the stars with nourishment from the same source as that from which he provided for sun and moon (Aëtius, II, 17, 4; Diogenes Laertius, IX, 9). Aristotle's meaning probably is that Heraclitus apportioned most of the nourishment and the purest of it to the sun which is nearer the earth than are the stars (Diogenes Laertius, IX, 10) and thereby overlooked the fact that the size and number of the stars in fact should require more nourishment than the sun (N. B. *τοσούτων καὶ τὸ πλῆθος καὶ τὸ μέγεθος ὄντων*, 355 A 20-21).

The insuperable difficulty urged against the above doctrine also presents itself in the theory of those who say that the region of the earth was first completely liquid and that the heat of the sun turned part of this liquid to air, from which winds arise and by which the "turnings" of the heavens are caused.<sup>544</sup> All the water which is vaporized and taken up into the atmosphere finally returns to the earth as rain; hence it cannot be used as the nourishment of heavenly bodies (as Heraclitus thought)<sup>545</sup> nor can it be true that some of the water once it is changed into air remains as air while only a

<sup>544</sup> *Meteorology* 355 A 21-32. *τοῖς φάσκουσι κ. τ. λ.* of 355 A 22 introduces the same doctrine as that outlined 353 B 6-11, but with more exactness. It is meant to represent the theory of Anaximander (page 131, note 529 *supra*). Alexander commenting on *Meteorology* 353 B 6 ff., misled by the compendious expression there, *τὸ μὲν διατμίσαν πνεύματα καὶ τροπὰς . . . ποιεῖν* explains that the sun and moon turn to the region where there is a plentiful supply of vapor; that is he makes Anaximander explain the "turnings" just as Heraclitus does. But, besides the fact that Anaximander seems not to have arranged for any nourishment of the sun and moon, 355 A 24-25 shows definitely that it is *air* and not moisture which causes the turnings. Heath, *Aristarchus*, p. 33, note 3, is inclined to follow Zeller in understanding these "turnings" simply as the revolutions of the heavenly bodies. But Aristotle is certainly using *τροπαί* (355 A 25) in the same sense as in 355 A 1 ff. where it must mean "solstices" (*περὶ διαίτης* I, 3 makes this certain, though Antiphon [Aëtius, II, 20, 15] used the Heraclitean theory to explain the rising and setting of the sun); a direct description of how Anaximander accounted for the solstices is lacking; but Aristotle's account along with doxographical reports of the theory held by Anaximenes and Anaxagoras (Aëtius, II, 23, 1 and 2; Hippolytus, *Refut.*, I, 8, 9) supports the belief that Anaximander, too, accounted for the solstices by the resistance of compressed air masses. (*τὰ ἄστρα*, Aëtius, II, 23, 1, which Heath cites as support for the interpretation of *τροπὰς ποιεῖσθαι* as "revolutions" means "the sun and moon" [cf. the "proper meaning" of *ἄστρα* according to Posidonius, *Doxog. Graeci*, p. 466, 20]; Aëtius, II, 25, 1 which he also cites cannot give the right explanation of eclipses according to Anaximander [cf. Aëtius, II, 29, 1; II, 24, 2]; and, if it did, *κατὰ τὰς τροπὰς τοῦ τροχοῦ* could not mean "according to the revolutions of the wheel." Diels supposes *ἐκλείπειν* to mean the daily disappearance of the moon; but it clearly has to do with the phases. The phrase *κατὰ τὰς ἐπιστροφὰς* of the parallel passage [*Doxog. Graeci*, p. 355 A 21] indicates an early corruption; but I think that an oscillatory swinging, a twisting, of the wheel and not its ordinary revolution is meant.)

<sup>545</sup> Aristotle forgets that according to Heraclitus the moisture which nourished the heavenly bodies is repaid by the fire which turns to water on the downward road.



portion reverts again to a liquid state.<sup>546</sup> The axiom that all of each simple body can and eventually does change into one of the others appears to Aristotle to invalidate the doctrines of both Heraclitus and Anaximander.

The question of the origin of the sea was connected with the problem of its salinity; Aristotle consequently returns to this point<sup>547</sup> after having established the doctrine that the place filled by the sea is the natural place, not of the sea as such, but of water.<sup>548</sup> It seems to be the place of the sea only because sweet water is quickly evaporated and leaves the salt behind because of its weight. Consequently all rivers and all water that has been generated flow into this basin as the natural place; the sea is then the goal (*τελευτή*) of all water rather than its *ἀρχή*; the *ἀρχή* of the sea is, on the other hand, the water which is generated from the moist exhalation.<sup>549</sup> Everyone who has represented the world as a product of generation has held the sea to be generated also, whereas if the world is eternal—as Aristotle himself holds—the sea and its salinity must share that characteristic.<sup>550</sup> Those who, like Democritus, think the sea is diminishing in size and will one day disappear are, Aristotle thinks, worse than Aesop who said Charybdis had already swallowed two-thirds of the sea and would some day finish it off with a third gulp, for he had a moral purpose in telling his fable but those who seek the truth have not that excuse for their theory.<sup>551</sup> Whatever reason they give for the original existence and persistence of the sea—as its weight, for example—this same reason will require it to

<sup>546</sup> Nowhere else do we find this refinement of Anaximander's theory. In fact, Hippolytus, *Refut.*, I, 6, 7 makes it seem improbable that Aristotle here is giving a true account; and the treatment of Heraclitus (cf. previous note) strengthens this suspicion, for it is the same element in his theory that is misrepresented. Some such reconstruction, however, was necessary to explain how the earth was to be eventually desiccated (cf. *Meteorology* 356 B 21-27).

<sup>547</sup> *Meteorology* 356 B 4-358 A 27.

<sup>548</sup> *Meteorology* 355 A 32-B 32; 356 A 29-B 3.

<sup>549</sup> In *Meteorology* 355 B 32-356 A 29 the theory of rivers given in Plato's *Phaedo* 111 C ff. is attacked.

<sup>550</sup> *Meteorology* 356 B 4-9.

<sup>551</sup> *Meteorology* 356 B 9-17.

maintain itself forever, for, unless they say that the water drawn up by the sun will not again descend, the sea must continue to exist. Moreover, since the sweet water is evaporated first, this sweet water must again descend before the sea has a chance to give up its salt water and so the sea will never be exhausted. The course of the sun is, in fact, the cause of the evaporation and condensation, so that so long as the sun follows its present course there can be no change in the nature of the sea; and, if the sun were halted, there would be nothing to cause evaporation.<sup>552</sup>

This notion that the sea is drying up he attributes to the fact that people have noticed some regions of the earth becoming drier than they formerly were; but he says that a further examination would show many places to be wetter than formerly. These are local conditions; and in each locality there is a cycle of drought and flood longer than the cycle of a single year but of exactly the same nature. It is absurd to think that the condition of the universe hangs upon changes such as these which are petty when considered in relationship to the size of the earth alone and still more insignificant when one remembers that the earth is as nothing to the size of the cosmos.<sup>553</sup>

As for the salinity of the sea, those who hold the sea to have been created cannot explain this phenomenon, for whether the sea is the remainder of the evaporation caused by the sun or all the sweet water originally contained the salt in the sea at present but did not appear saline because of the small proportion, still, since the evaporated water returns as rain, the whole quantity is equal and could not appear saline now if it did not then. Or if it appeared saline then, the cause for

<sup>552</sup> *Meteorology* 356 B 17-30.

<sup>553</sup> *Meteorology* 356 B 30-357 A 4 and at greater length in 352 A 17-B 16 where against the theory of subterranean chasms (cf. page 129, note 523 *supra*) the existence of everflowing rivers is explained by periodic floods of rain in mountain districts. Aristotle intimates that from such local changes conclusions concerning the generation and alteration of the cosmos were drawn (cf. page 131, note 529 *supra*), conclusions which are antagonistic to the fundamental thesis of his physical doctrine. The eternity of change in the sublunar world is based upon the necessary eternity of motion (cf. pages 181-83 *infra*), and the eternity of change requires that the existence of the world in its present form be continuous.

this salinity still remains unexplained.<sup>554</sup> This complicated argument is remarkably weak, since all the Presocratics explained that only the sweet water was evaporated, so that even the second theory would stand, while Anaximander explained that the water left behind became salty because of some burning effect of the sun.<sup>555</sup>

Again those who say that the rivers bring salty earth down into the sea fail to explain why the rivers themselves are not saline, although it would seem that a mixture of such earth should be more noticeable in each river than in the great confluence of river water which constitutes the sea.<sup>556</sup> The statement of Empedocles that the sea is the sweat of the earth is likewise absurd for, poetical though it may be, it does not explain the nature of the object under investigation. In fact, it rather suggests another question, the manner in which the sweet liquid imbibed becomes saline sweat. If Empedocles would answer this by saying that sweat is saline because it has been filtered through flesh just as urine is salty because of the admixture of substance left over in the digestion of food, his metaphor would reduce to the theory that the sea is saline by reason of the admixture of particles of earth. But he should then have told how so much water can be separated out of earth when it is heated and why the same result cannot now be attained by heating earth. Aristotle here refuses to admit that this separation could have been a single cosmogonical act no longer possible because the water has been exhausted from between the particles of earth. He then ridicules the metaphor as applied to a moist body, supposing that what is being dried cannot be said "to sweat," and prefers the theory that the sea is the remainder of evaporation to the notion that a moist earth perspires.<sup>557</sup> These objections to Empedocles' theory are

<sup>554</sup> *Meteorology* 357 A 5-15.

<sup>555</sup> Aëtius, III, 16, 1; III, 4, 4; Theophrastus, *fragment* 23 (*Doxographi Graeci*, p. 495, 1-3); cf. Gilbert, *op. cit.*, p. 413.

<sup>556</sup> *Meteorology* 357 A 15-24. The theory is that of Xenophanes, but Aristotle probably means to include with it that of Anaxagoras and Metrodorus (*Doxog. Graeci*, p. 495, 6-11; cf. page 132, note 533 *supra*; Gilbert, *op. cit.*, p. 408, n. 1).

<sup>557</sup> *Meteorology* 357 A 24-B 21. N. B. Aristotle himself uses the metaphor of the sweating earth in describing the seepage of water, *Meteorology* 350 A 1-2.

for the most part curiously petty; only the proof that his explanation is really a filtration theory is appropriate, and this is obviously just what Empedocles meant it to be. Aristotle's constant concern to discredit Empedocles causes him to collect every possible argument without regard for propriety, whenever a theory of that Presocratic is under discussion.

His own explanation, however, admits that the salinity of the sea is connected with the heating of the earth,<sup>558</sup> inasmuch as it is due to the dry exhalation which, rising from the earth, mixes with the moist exhalation and is carried into the sea by the rain generated from the moist vapor. The dry exhalation is the state of earth which is changing into fire; as earth which has not been completely mastered by heat, it is a kind of ash corresponding to the substance remaining unassimilated by digestion in organic bodies. So the sea is explained by the axiom of the generation of simple bodies from one another, its moisture being the result of the interchange of air and water, its salinity by that of earth and fire; and previous theories of whatever kind should never have seemed even plausible, Aristotle thinks, since they all fail to save the most obvious phenomenon, the real generation and destruction of the four simple bodies.<sup>559</sup>

The criticism of previous explanations of thunder and lightning follows the same pattern. Empedocles and Anaxagoras are the only Presocratics whose theories in this matter are seriously considered.<sup>560</sup> Both had connected the phenomena with

<sup>558</sup> *Meteorology* 357 B 23-358 A 27. Cf. 357 B 14-16: those who say the sea arose *ἐκ κατακεκαυμένης γῆς* must be the school of Empedocles once more.

<sup>559</sup> *Meteorology* 358 B 23-34. N. B. the natural tendency of the dry exhalation to rise is proof that there is a real change in the attributes of the substrate, i. e. that earth is really passing away and fire coming to be in this stage.

<sup>560</sup> *Meteorology* 369 B 11-370 A 32. The notion of Cleidemus that lightning is merely an apparent brilliance due to the "striking of the water in the cloud" analogous to the phosphorescent gleam of a body of water struck by a staff is dismissed by Aristotle with the remark that this theory was held by people who had not yet learned the laws of the reflection of light by which the stream of vision is reflected from the smooth water to some brilliant object (*Meteorology* 370 A 10-21). This theory is essentially that of Anaximander, Anaximenes, and probably Xenophanes (cf. Aëtius, III, 3, 1, 2, 6); it asserts that lightning



fire, the former saying that rays of the sun were enclosed by clouds, the latter that fire descended from above into the clouds, and both explaining that lightning was this fire gleaming through the cloud and thunder the noise of its quenching so that lightning precedes thunder really as well as apparently.

The theory as developed by Anaxagoras requires fire to move downward into the clouds; but, since that is motion contrary to the nature of fire, Aristotle objects that Anaxagoras would have to assign some reason for such motion and should also have explained why this happens only when the sky is overcast. The alternative of Empedocles is no better explanation, for it assigns a constant condition as the cause of sporadic occurrences. This criticism leads to the underlying objection against all such explanations. If these phenomena are the result of the separation of preëxisting elements, their intermittence requires explanation; moreover, when hot water freezes, heat particles ought to be squeezed out of it, a necessary conclusion of this hypothesis which manifestly does not occur. Lightning and thunder like all meteorological phenomena, must be due to the genesis and destruction of the four elements;<sup>561</sup> for Aristotle they can be explained only as the action of the dry exhalation changing to fire when the clouds that enclose it are driven together.

The dry and moist exhalations have been called intermediate stages in the change of earth to fire and water to air respectively. Both exhalations are due to the activity of external heat, the heat of the sun, upon earth and water; and the almost complete victory of this heat over the natural cold of these two "elements" brings about the destruction of them and the genesis of two bodies that are *almost* fire and air. But Aristotle provides for another kind of interaction among these elemen-

is not self-existent, i. e. that it is not fire (*τὴν ἀστραπὴν οὐκ εἶναι φασιν ἀλλὰ φαίνεσθαι*), and it is this implication which alienates Aristotle.

<sup>561</sup> Earthquakes, too, are due to the dry exhalation (*Meteorology* II, chap. 8); but, since in this case the exhalation is a mechanical cause, his criticism of previous theories does not stress the necessity for generation and destruction of the elements (cf. pages 207 ff. *infra*).

tary bodies, an interaction of the four bodies to form a new homogeneous body by alteration of the components which results in a real unity from which, however, by some process the components may be recovered in their original state.<sup>562</sup> This form of mixture, or chemical combination (for that is what it means to be), can take place only when the potencies of the bodies concerned are very nearly equal, so that each component changes in the direction of its opposite but is not completely destroyed to generate another element. The result is a kind of qualitative suspension of the simple bodies, the varying degrees of intensity at which this suspension is reached determining the character of the resulting homogeneous body.<sup>563</sup> The explanation of what he means by mixture in this sense is Aristotle's answer to those people who say that one thing cannot be mixed with another.<sup>564</sup> The distinction between generation-destruction and combination and an understanding of potential and actual as modes of being he believes solve this paradox at once.

Although Aristotle is inclined to interpret the "mixture" of Presocratic physics as similar to his own "chemical combination" when he seeks among his predecessors precedent for his own doctrine of prime matter and alteration,<sup>565</sup> he is equally concerned, when defending the propriety of his new theory, to show that the previous conception of "mixture" was quite different from his own. Obviously the Presocratics, if they did not understand qualitative alteration, could not hold any theory of combination in Aristotle's sense; but Aristotle cannot at any time completely abandon the belief that everyone who used the

<sup>562</sup> *De Generatione* 328 A 10-16; 328 B 17-22. For a concise account of *μῖξις* see Joachim, "Aristotle's Conception of Chemical Combination," *Journal of Philology*, XXIX (1904), pp. 72-86.

<sup>563</sup> *De Generatione* 328 A 26-31. Joachim, *ibid.*, pp. 81-83.

<sup>564</sup> *De Generatione* 327 A 34-B 10. These critics are represented as arguing that if the components exist and are not altered there is no mixture; whereas, if one or both of the original components have ceased to exist, they cannot "be mixed," for they do not exist. This argument bears an obvious relation to that against change and "being and non-being" cited in *Physics* 240 A 19-29. The type of argument is derived from Zeno but was not used for this purpose by Zeno himself as that passage shows. It is very probably Megarian (see Simplicius, *Phys.*, 120, 13-20 and page 89, note 378 *supra*).

<sup>565</sup> E. g. *Physics* 187 A 20-26; see pages 50-51 *supra*.



words *μίξις* and *μίγμα* was striving to express the theory now for the first time fully elaborated. It is on this assumption alone that he criticizes those who say that "at one time all things were together," that is that all things were in a state of mixture.<sup>566</sup> Such a statement implies that qualities were combined, whereas only things that have substantial existence are capable of combining. This incidental criticism of Anaxagoras and Empedocles depends upon Aristotle's own doctrines of qualitative change and of the adjectival nature of qualities and assumes that the "mixture" for both thinkers must have meant something other than a merely mechanical shuffling together of ultimately immutable matter.<sup>567</sup>

The popular conception of mixture as a merely mechanical aggregation of imperceptible quantities was in reality the common doctrine of the Presocratics except in so far as it was refined by the Atomists in the light of indivisible bodies. The latter doctrine required that the atoms of each component in the mixture be *evenly* distributed throughout the new complex. These two conceptions of the problem are essentially the same for Aristotle;<sup>568</sup> according to both mixture and aggregation are one and the same thing, whereas Aristotle insists that no aggregation can result in a truly homogeneous body while the essential characteristic of true mixture is just its homogeneity.<sup>569</sup> The atomic theory of mixture is further invalidated by its assumption of indivisible bodies, while the infinite divisibility of matter makes it impossible for the components of a compound to be evenly distributed throughout its extent. From the fact that from any given section of a true compound the

<sup>566</sup> *De Generatione* 327 B 19-22.

<sup>567</sup> Cf. the criticism of Anaxagoras in *Physics* 188 A 5-13 (page 51 *supra*) and the interpretation of Anaxagoras, Empedocles, Anaximander, and Democritus in *Metaphysics* 1069 B 20-23 (pages 56-57 *supra*), where in attempting to correct the material principle of these thinkers by the requirements of his own "prime matter" Aristotle proceeds on the assumption that it was for all of them a "mixture" in his own sense.

<sup>568</sup> *De Generatione* 327 B 32-328 A 17.

<sup>569</sup> Joachim, *On Coming-to-Be and Passing-Away*, p. 183, points out that the chemical combination of modern chemistry would for Aristotle be merely aggregation, since a compound is the result of a re-arrangement of the atoms in the constituent bodies.

same components may be extracted by analysis, the homogeneity of the compound is ascertained and therewith the explanation of the composition as aggregation in the manner of Empedocles' theory is refuted.<sup>570</sup> The problem of the constitution of homogeneous compounds seems to Aristotle insolvable unless the generation of the simple bodies from one another be assumed, but still insolvable if this alone be granted.<sup>571</sup> Those who assume a plurality of elements, if these be themselves immutable, are forced to suppose that the more complex bodies are mere aggregates of the simple bodies; those who posit a single material substrate for the simple bodies have still to explain how an homogeneous body can be generated from two or more of these. This can be done only by supposing that the change of a simple body need not be *complete* destruction, since that would result in the generation either of another *simple* body or of the bare substrate, but that there are relative degrees of change for the "elements."<sup>572</sup> This *limited* alteration of the elements by the active power of one another is the mechanism of mixture, which performs a necessary function in the explanation of the physical world on the basis of alteration, generation, and destruction.<sup>573</sup>

<sup>570</sup> *De Generatione* 334 A 15-B 7.

<sup>571</sup> That is, he thinks that Plato explains it no more than do the Presocratics.

<sup>572</sup> *De Generatione* 334 B 7-30.

<sup>573</sup> The refutation of Empedocles' explanation of the sterility of mules (*De Gen. Anim.* 747 A 26-B 28) is fundamentally an attack on his theory of mixture. Both Democritus and Empedocles are first criticized for giving an explanation which applies to all hybrids whereas not all hybrids are sterile. Democritus said that the sterility was due to the fact that the passages of mules were "ruined" because mules do not spring from parents of the same kind. Although Aristotle himself says that the meaning of this statement is obscure, it seems to be closely related to the theory of Empedocles which makes mixture depend upon the congruence of pores and effluences. Empedocles said that the seed of the male and female, being soft in both cases, fit together and form a dense mixture as is the case when bronze and tin are mixed. This explanation of mixture as "the fitting together of hollows and solids" in the constituents is unintelligible according to Aristotle, who further argues that the seed of horse and ass, both male and female, is all soft so that on this theory horses and asses ought also to be sterile. (In his eagerness to refute Empedocles Aristotle claims that male mules *do* generate at seven years and that females conceive but cannot develop the embryo.)



## SPACE, MOTION, WEIGHT, AND TIME

None of his predecessors, Aristotle says, recognized the problems of space and local position.<sup>1</sup> The common notion that whatever exists must be somewhere because what does not exist is nowhere and the fact that the principal species of movement is locomotion appear to be the bases for the acceptance of position as real;<sup>2</sup> from the observation that bodies change position, then, there arose the notion of place as extension separate from body itself,<sup>3</sup> a conception which is attributed even to Hesiod on the evidence of his statement that Chaos was the first of all things and next broad-breasted Earth.<sup>4</sup> The notion of place as separately existing then became the concept of space as an objective existence essentially unconnected with body which may fill it; the void for those who assert its existence is just place or position unoccupied.<sup>5</sup> Apart from Plato, however, who identified space and matter, no one attempted to say what is this space or place which all assert exists.<sup>6</sup>

Since for Aristotle extension exists only as a phase of cor-

<sup>1</sup> *Physics* 208 A 34-B 1.

<sup>2</sup> *Physics* 208 A 29-32.

<sup>3</sup> *Physics* 208 B 1-8.

<sup>4</sup> *Physics* 208 B 27-209 A 2—cf. *De Melisso* 976 B 14-17; Hesiod, *Theogony* 116. Deichmann (*Das Problem des Raumes*, Halle, 1893) follows Aristotle in interpreting Chaos as empty space, "die von den Dingen nicht erfüllte Form"; the account of the offspring of Chaos (123 ff.) shows that it is not thought of as "the real form of things," that is as an abstraction from the corporeality of bodies, and that Chaos and Earth are two separate elemental forms of existence independent of each other and with parallel lines of development. Earth arises neither out of Chaos nor in it; consequently Chaos is not space either as form or as matter and, of course, not as pure extension.

<sup>5</sup> *Physics* 208 B 25-27.

<sup>6</sup> *Physics* 209 B 16-17. The Eleatics denied the existence of space, that is of position apart from the one unalterable Being; cf. *Physics* 209 A 23-26, 210 B 22-23 (Zeno); Hippolytus, *Refut.*, I, 11 (Parmenides) and Parmenides, *fragment* VIII, 41. For the latter the fragment shows that *τόπος* implied empty space, i. e. the void.

poreality<sup>7</sup> there is no problem of space as such; the questions touching continuity, finitude, etc. are questions of the characteristics of matter. The result of this doctrine is that space is the sum of all the places, of all the positions of all matter, in the cosmos;<sup>8</sup> consequently the difficulties of the relation of space to bodies in space become for Aristotle problems of the mutual relationship of positions of bodies and their parts. Zeno had objected to the concept of space that if every existing thing is in space there must be a space of space and so on *ad infinitum*.<sup>9</sup> This argument is a refutation of the doctrine that there can be more than a single Real Being; it is in accord with the purpose of Zeno's dialectic as given by Plato.<sup>10</sup> If what exists must be in something else, then this container as existing must also be in a third existing thing; in so far as the argument proves that the cosmos itself is not in space one would expect Aristotle to have welcomed it. But he recognized that the same reasoning would prevent any existing individual body in the world from being in position as contained by another body, in short that it requires unbroken continuity of Being; and he consequently argues against Zeno that the first position of the given body may be in something else otherwise than in position; for example, as state or quality is *in* an object.<sup>11</sup> The position of a body, however, is the first unmoved limit of that which contains it, and Aristotle finally escapes the application to his own theory of Zeno's argument only by denying that the universe as a whole has position.<sup>12</sup> He does not, however, show that he is aware of the purpose of Zeno's criticism which is to emphasize the difficulty involved in a pluralistic theory of discontinuous Being.

<sup>7</sup> *Physics* 216 A 24-26; 213 A 31-B 2; 211 B 19-29.

<sup>8</sup> There can be no place apart from matter (*Physics* 211 B 14-29, 216 B 2-16) and there is no place or void outside of this universe (*De Caelo* 279 A 11-18; cf. page 148, note 24 *infra*).

<sup>9</sup> *Physics* 209 A 23-26.

<sup>10</sup> *Parmenides* 128 C-D.

<sup>11</sup> *Physics* 210 B 22-27. Cf. *Physics* 212 B 27-28: "position or place is, to be sure, somewhere but not as in position; it is as the limit in that which is limited."

<sup>12</sup> *Physics* 212 B 14; cf. Simplicius, *Phys.*, 564, 2-13.

The Presocratics who considered space at all were impelled thereto by the exigencies of physical problems and so were interested chiefly in the possibility of a void. Such of them as posited the existence of a void thought of it as a spatial container which was full or empty according as it held or did not hold the corporeal mass it was able to contain.<sup>13</sup> Consequently Aristotle feels that an examination of this theory and of the nature of void as such is pertinent and necessary in a thorough discussion of space and position.

In the first place he explains<sup>14</sup> that the experiments of Anaxagoras and others to show that air has resistance and so is a body do not offer any evidence against the possibility of a void.<sup>15</sup> Those who posit a void mean by it an extended interval in which there is no sensible body, for, thinking that all existence is corporeal, they do not mean that the air is the void but that in which there is no body whatsoever. Consequently the refutation must show not that air is a body but that there is apart from bodies no extension either separable or actually existing so as to make corporeal existence discontinuous, as Democritus, Leucippus, and many other physicists<sup>16</sup> say there is, or existing outside of the whole corporeal world taken as continuous. Although the proof that air is corporeal does not refute the possibility of a void as posited by the Atomists, Aristotle does not do justice to the consequences of the experiment, for it would have been such conceptions of the void as the Pythagorean against which Empedocles brought his evidence. The Pythagoreans evidently confused emptiness with atmospheric air as their metaphor of "breath" shows;<sup>17</sup> if air is corporeal, this naïve conception of "emptiness" is elim-

<sup>13</sup> *Physics* 213 A 15-19.

<sup>14</sup> *Physics* 213 A 22-B 2.

<sup>15</sup> For the experiment of "twisting skin bags" cf. Simplicius, *Phys.*, 647, 22-26; the experiment of the pipette is described in [Aristotle], *Problem*, XVI, 8 (914 B 9 ff.), where it is attributed to Anaxagoras, although Empedocles had drawn the same conclusions from observing this phenomenon (cf. Empedocles, *fragment* 100 quoted by Aristotle, *Parva Natur.* 473 B 1 ff.) and had employed the experiment to explain the process of respiration.

<sup>16</sup> E. g. Xuthus, Ecphantus, Metrodorus of Chios.

<sup>17</sup> *Physics* 213 B 22-27 and Aristotle, *frag.* 201.

inated once for all. Anaxagoras, however, if he was trying to show that there is no physical evidence of the void as it was later conceived by the Atomists, is open to Aristotle's criticism;<sup>18</sup> and it may be for this reason that he alone is named in connection with the experiments here.

On the other hand those who argue for a void say that without it motion—that is, both translation and growth—would be impossible, for what is full cannot receive anything unless one asserts that two bodies can be in the same place at once which amounts to admitting that the smallest body can contain the largest.<sup>19</sup> Melissus who denied the existence of a void proved on the basis of this argument that there can be no motion.<sup>20</sup> The phenomena of compression, of growth, and of the saturation of ashes by liquid are also said to be explicable only on the hypothesis of a void,<sup>21</sup> for a jar will hold both the amount of wine which filled it and the wine sack into which that wine has now been poured,<sup>22</sup> nourishment is corporeal and two bodies cannot be together in one place, and a container can hold as much ash and water at once as it holds of either separately.<sup>23</sup> The Pythagoreans posited a void for the purpose of explaining individuation, supposing that the world inhaled, as it were, the infinite breath outside its boundary. This inhaled void, they thought, was the principle which

<sup>18</sup> The justice of Aristotle's criticism of Anaxagoras depends upon a knowledge of the view he was trying to refute. Deichmann (*op. cit.*, p. 8, n. 1) supposes that his opponents considered their void to be "something concrete." But Anaxagoras probably knew that Empedocles had already shown that "breath" is corporeal. Unless he merely "repeated" the experiment, he probably was trying to prove that there is no widely extended void in our world. Or he may have meant only to show that the resistance of the air was sufficient to support the earth according to his explanation (cf. Simplicius, *De Caelo*, 520, 28-31).

<sup>19</sup> *Physics* 213 B 4-12.

<sup>20</sup> *Physics* 213 B 12-14; Melissus, *frag.* VII, §§ 7-10. The Atomists, then, according to Aristotle, accepted the void as a necessary condition for motion but asserted that such a void does exist (*De Generatione* 325 A 25-32; cf. page 95, note 401).

<sup>21</sup> *Physics* 213 B 15-22.

<sup>22</sup> For an explanation of this marvel in accordance with the Aristotelian suggestion in *Physics* 214 A 32-B 1 see [Aristotle], *Problem.* 938 B 14-24.

<sup>23</sup> This is explained in [Aristotle], *Problem.* 938 B 24-939 A 9.



separated and delimited consecutive objects and existed first of all in numbers since it is void which distinguishes the numbers from one another.<sup>24</sup>

Against this Pythagorean theory Aristotle advances no special refutation, for he holds the general objection which he first makes to the concept of a void<sup>25</sup> sufficient answer to this special doctrine. All who posit a void, since they suppose that being is corporeal and all body has position, think that place without body is empty. Consequently they think of the void as place in which there is nothing; but, since they think of body in general as tangible and that is tangible which has weight or lightness, that in which there is nothing light or heavy is void. Yet according to this definition a mathematical point would be a void, but this is absurd for place involves the notion of extension of tangible body. If then we recall that the limits of bodies, planes, and lines are respectively planes, lines, and points and that these limits are in those things which they limit and so individuate,<sup>26</sup> it appears that by this argument Aristotle believes that he has eliminated what the Pythagoreans supposed to be the necessity for positing a void. The argument further enforces the inclusion of extension in the notion of empty space; and upon the concept

<sup>24</sup> *Physics* 213 B 22-27. In *frag.* 201 Aristotle calls this inhalation from the infinite "time and breath and the void that at all times distinguishes the 'fields' (*χώρας*) of each and every thing." In *De Caelo* 279 A 11-18, after having shown that all matter is involved in the one universe so that there cannot be more than one, he concludes that there is "no place or void or time" outside the universe, since place is that in which body can exist and void is place in which there is no body present though it could contain body. But it has been proved that no body could exist outside the one universe.

<sup>25</sup> *Physics* 213 B 31-214 A 11.

<sup>26</sup> See *Metaphysics* 1060 B 12-17. Since only mobile body has position (*Physics* 212 B 28-29) a spatial distinction of numbers, for example, is absurd. But even things having position are separated from one another by planes, lines, points, i. e. limits which are in the thing limited (*Physics* 212 B 27-28). The limit which is the position of an object, however, is not in that object but is the inner extremity of the enveloping object. Thus the extremities which, as limits, are form and position coincide spatially but are essentially other, the form being the limit of the object, its position the limit of the envelope (*Physics* 211 B 10-14).

as so corrected the criticism is then turned, for, if the void is that which is empty of body sensible to touch, that is of body having weight or lightness, is extended color or sound a void or not? If it can receive a tangible body it is void; if not, it is not. Consequently the void is essentially the place of body deprived of that body which can fill it,<sup>27</sup> in other words it is the interval or extension of body which has come to be thought independent of the body which fills it because apparently bodies replace one another. Both the void, then, and separately existing place are conceived as extension in which the movement of bodies occurs. But place, as separately existing extension, involves an infinite number of such places, since every part of a body as well as the whole body and its container will have its own place; moreover the place of a part will change with that of the whole and this with that of the container, so that there will be a place of place or extension in which another extension exists and there will be a coincidence or overlapping of many places. It is, however, clear that the place of the contained object and that of its parts remain the same when the container changes position.<sup>28</sup> Consequently, extension cannot exist save as an essential characteristic of body; and it makes no difference whether the separable extension be thought of as empty or always occupied by some body or other. This is not a cogent argument against the hypothesis of separately existing *continuous* extension. It depends upon the confusion, which Aristotle attributes to his predecessors, of space and specific position; the difficulty is then complicated by transferring from material objects to their positions in space the problems of the part and the whole.

Since the void is posited as a necessary condition of motion, Aristotle tries to show first that the hypothesis is unnecessary.<sup>29</sup>

<sup>27</sup> *Physics* 214 A 16-26. In 214 A 11-16 the Platonic theory of extension as material substrate is treated as equivalent to the notion of void as matter. The doctrine of Plato is considered in 209 B 6-16, 209 B 21-210 A 11, 211 B 29-212 A 2.

<sup>28</sup> *Physics* 211 B 14-29. Cf. 214 B 24-28: if a body be in place as separately existing or in a void, yet the parts of that body are not in separate space but in the whole body. How then is the whole in a separately existing place?

<sup>29</sup> *Physics* 214 A 26-B 10.



Alteration, he claims against Melissus,<sup>30</sup> can take place in a plenum; so not all motion requires a void. But local motion by mutual replacement of two bodies can occur without a separately existing void as is proved by the whirls of continuous bodies. On the same principle compression can be explained by the expression of foreign particles in the body compressed<sup>31</sup> and growth by alteration as well as intussusception.<sup>32</sup> In fact, Aristotle tries to show that the explanation of growth and saturation by means of a void is self-contradictory, for, if in growth each and every part grows and does so by corporeal accretion and if two bodies cannot coincide, then the whole body must be a void. The same result is necessary if saturation be explained by means of a void. This paradox is plausible only so long as one forgets the doctrine of minimal quanta which was a part of the Atomistic theory here attacked. The partisans of the void proceeded on the assumption that bodies exist in space; but Aristotle, stressing the extension of body itself and assuming that growth requires an alteration continuous throughout the whole body,<sup>33</sup> argues that the growing body must be dissolved into empty space in order that the accretion by which it grows may be thorough and continuous. So he makes it appear that this argument for extended empty space requires for consistency that there be no extension that is filled, and from his own conception of space as *within* body argues that with the growth of body space must also increase.<sup>34</sup> Yet in his own explanation of growth he has to deny the possibility of *material* increase in every particular part of the growing body,<sup>35</sup> an assumption which is necessary for the present refutation.

The direct refutation of the possibility of a void depends upon a series of demonstrations that empty space is incon-

<sup>30</sup> Melissus, *fragment* VII, § 7. But Melissus had no knowledge of alteration in Aristotle's sense and would have denied that it is possible without local motion; cf. pages 70-71 *supra*.

<sup>31</sup> See Melissus, *fragment* VII, § 8, *Physics* 216 B 22-26.

<sup>32</sup> See Simplicius, *Phys.*, 1319, 4-5 and [Aristotle], *De Melisso* 976 B 37-977 A 4 (but read the text of Diels, Berlin, 1900).

<sup>33</sup> See *Physics* 260 A 29-33, *De Generatione* 321 A 17-24.

<sup>34</sup> Cf. C. Deichmann, *op. cit.*, p. 95. <sup>35</sup> *De Generatione* 321 B 22-322 A 4.

sistent with the phenomena exhibited by moving bodies. The void cannot be the cause of motion if each of the simple bodies has as one of its essential characteristics movement in a certain direction;<sup>36</sup> in fact, there can be no reason why a body placed into a void should move in any direction or remain anywhere. The same difficulty presents itself to position regarded as separate from body though always filled by some body or other, for the void is simply empty place and place is the terminus of translation. But motion requires absolute differentiation of direction which is impossible in a void and inexplicable on the theory of separable position.<sup>37</sup> Furthermore, not only does the hypothesis of a void not explain motion as its partisans suppose it does; it is not even possible for motion to occur in a void,<sup>38</sup> for what some give as the cause of the earth's stability, namely its equilibrium or equiformity,<sup>39</sup> would be a true description of the state of affairs in empty space, where the absence of all differentiation would require the absence of motion. Lack of differentiation in direction makes natural motion in a void impossible; and since motion by constraint requires the prior existence of natural motion there can be no movement of any kind in a void, for, even apart from this argument, the mechanism of propulsion or of counter-pressure by which the movement of projectiles is explained could not function in a vacuum. But, if a body were there in motion, it would have to continue moving forever since there could be no reason for it to stop at one point rather than another; furthermore, since the void is introduced because it seems that motion can be only in the direction of no resistance, the body moving in the void would move in all directions at once.<sup>40</sup>

<sup>36</sup> *Physics* 214 B 13-17.

<sup>37</sup> *Physics* 214 B 17-24. Place requires differentiation of direction, *Physics* 210 A 2-5. The same argument is used against an infinite body; cf. pages 30 and 33-34 *supra*.

<sup>38</sup> *Physics* 214 B 28-215 A 1.

<sup>39</sup> So Anaximander according to Aristotle, *De Caelo* 295 B 10-16; Plato, *Phaedo* 108 E 4 ff., *Timaeus* 62 D 12 ff.; Aëtius, III, 15, 7 (but cf. Simplicius, *De Caelo*, 520, 31).

<sup>40</sup> *Physics* 215 A 1-24.



Supposing that the speed of a given body moving through equal distances of two media differing in density varies in inverse ratio to the density, Aristotle next argues that the void can stand in no proportion with any density and movement through a void cannot have any speed proportionate to that through a plenum. But, since all movement takes place in time, the time in which a body traverses a given void will be proportionate to the time in which it traverses an equal course through a plenum. But this proportion between the two times requires that there be a ratio of density between the two courses, which would be the case if the first course were not a void. Consequently a body can traverse an equal course through a void and through a plenum in equal times, an impossibility due, according to Aristotle, to the fact that, while any two movements are in proportion (since any two times are), there can be no proportion between a void and a plenum.<sup>41</sup> The real error in this argument is the assumption that velocity varies inversely with the density of the medium; but, even on Aristotle's assumption, he should have seen that the velocities in media of constantly diminishing density would approach that through the void as a limit so that through the medium of zero density a body would have an infinite velocity<sup>42</sup> which would stand in no proportion to velocities through other media.

Again appealing to experience for the law that, if the shape of both is the same, of two bodies having weight the heavier falls the faster and with an excess speed directly proportionate to its excess weight (while of two having "lightness" the lighter rises faster), Aristotle claims that in a vacuum this necessary law of motion would not hold. In a plenum the body with the greater "force" divides the medium more swiftly, but in a void there is no medium so that all bodies should move with equal speed. But this is absurd, for it amounts to saying that all would have equal weight since specific weight is determined by the tendency to move in a certain

<sup>41</sup> *Physics* 215 A 25-216 A 11.

<sup>42</sup> He seems vaguely to see this possibility, although he does not press it, when he considers the question of a mobile void in the argument concerning the void as the cause of upward motion (*Physics* 217 A 6-8).

direction with a definite velocity.<sup>43</sup> Velocity is for Aristotle a function of absolute weight and lightness which are essential characteristics of all matter; but this view of natural motion and proper place is incompatible with the hypothesis of a void, for to it motion is explicable only as the actualization of a qualitative differentiation of space which, as extension, can be only an exclusive characteristic of corporeality.

This last consideration is most important for Aristotle's notion of space, and he seeks to prove it as follows.<sup>44</sup> Any body, a cube for example, displaces of the body into which it is placed a volume equal to its own and displaces that body in the direction of its natural motion. But void, being incorporeal, could not be so displaced; it must then penetrate the cube placed into it. So the volume of the cube, that is the extension of the cube apart from all other qualities, will coincide with the volume of empty space penetrating the cube; and there will be no difference between the body of the cube and the space occupied, so that there is no more reason to suppose the coincidence of two such entities than of an infinite number. Moreover, since the cube retains its volume when it is displaced and this volume does not differ from space, there is no reason to posit a space for bodies to fill apart from their own volume.

There is a final argument in favor of the void to be met, that one which claims that compression which is necessary to explain condensation and rarefaction requires the assumption of a void and that condensation and rarefaction are required for spatial motion, since otherwise "the universe would bulge" as Xuthus put it.<sup>45</sup> Every change of one body into another would require a simultaneous reciprocal change of an equal

<sup>43</sup> *Physics* 216 A 11-21.

<sup>44</sup> *Physics* 216 A 26-B 16.

<sup>45</sup> *Physics* 216 B 22-217 A 10. The device of simultaneous reciprocal alteration was not considered by Xuthus as the word order shows, and the following explanation suggests that Aristotle himself developed it out of such doctrines as that of Heraclitus (cf. *fragments* 30 and 31, Diels) and the Platonic *τεπλωσις* (*Timaeus* 79 B ff.) combined with his own theory of generation and destruction. In *Physics* 217 A 15-21 circular alteration and circular translation are considered as two separate possibilities (cf. *De Melisso* 976 B 27-29 where the two are confused).



amount if there were no void to allow for compression and extension. As existing separately a void has already been proved to be impossible; but there are further difficulties if the claim is that empty space exists diffused through bodies. It would exist in rarified bodies and be the cause of their lightness; but in that case it would be the cause not of all motion but only of upward motion and that not as the medium but as itself having motion which it imparts to the bodies continuous with it. This would imply a void of the void, that is a proper place of empty space; and absolute void would have the maximum velocity, whereas the void is immobile itself for the same reason that motion in the void is impossible, namely the incommensurability of velocities. Moreover such a theory would not explain downward motion. Aristotle's criticism does not meet the special arguments for a void on this theory but falls back upon the thesis that it cannot explain natural motion and absolute weight. He, further,<sup>46</sup> admits the necessity of explaining compression and grants that the theory of simultaneous reciprocal change will not stand; but, since he cannot admit the existence of a void, he explains dense and rare as two phases of the primary inseparable matter which is potentially both.<sup>47</sup> Empty space, the void, then, can have no meaning save as an arbitrary term for the cause of locomotion;<sup>48</sup> in this sense it would be the matter of the heavy and the light, or, rather, of the dense and the rare which in their character of heavy and light are the cause of motion. But as hard and soft they are the cause of affection and so of alteration; so the void is reduced to Aristotle's prime matter, space is sunk in this matter as extension, and position becomes a secondary problem in the theory of motion.

The fact of motion must be accepted by the physicist. The Eleatic denial of its reality is a denial of the science itself, for to deny that there is motion is to deny the existence of a physical principle, since such a principle must be the principle of something else, a requirement which a single immobile

<sup>46</sup> *Physics* 217 A 10-21.

<sup>47</sup> *Physics* 217 A 21-B 20.

<sup>48</sup> *Physics* 217 B 21-26.

reality cannot fulfill.<sup>49</sup> With such a thesis a physical investigation is not concerned; each particular science is bound to resolve those questions only which arise from the principles of that science.<sup>50</sup> Induction from experience, Aristotle says, is sufficient evidence for the hypothesis of motion;<sup>51</sup> to refuse the evidence of sensation in this case is to doubt the very existence of nature<sup>52</sup> and of all sciences, since all make use of this hypothesis of *physics*.<sup>53</sup> Even if true reality were infinite and immovable, as some say,<sup>54</sup> still *apparent* motion must be admitted; and, though this be false opinion or imagination, motion of some kind there must be all the same, since imagination and opinion are themselves motion of a kind.<sup>55</sup>

The four arguments of Zeno, however, Aristotle feels it incumbent upon him to answer, since they seem to be direct proofs of the impossibility of motion. These arguments in the order which Aristotle gives as original<sup>56</sup> are 1) the dichotomy according to which a moving object must traverse half its course before reaching the goal and half of that before reaching the middle point and so on infinitely, 2) the Achilles which proves that, if of two objects in motion the slower has started to move first, it can never be overtaken by the swifter because the latter must first reach the point the former has left and the slower will always have moved on from that point, 3) the arrow in motion which cannot move because at

<sup>49</sup> *Physics* 184 B 25-185 A 5.

<sup>50</sup> *Physics* 185 A 14-17. So Aristotle claims that the refutation of Antiphon's method of squaring the circle does not fall within the province of the geometer while the consideration of the method by means of lunules does. Cf. *Soph. Elench.* 171 B 12-18, 172 A 2-7. On the implied criticism of Antiphon cf. Heath, *A Manual of Greek Mathematics*, p. 141.

<sup>51</sup> *Physics* 185 A 13-14.

<sup>52</sup> Nature is the principle of motion and rest in those things which naturally exist (*Physics* 192 B 13-23).

<sup>53</sup> *Physics* 253 A 32-B 6.

<sup>54</sup> Aristotle here chooses Melissus (cf. *Physics* 185 A 32) as the representative of those who deny the possibility of motion, although elsewhere he names Parmenides and Melissus together (*Physics* 184 B 16). The particular addition of Melissus, the infinitude of Reality, has no bearing on the question.

<sup>55</sup> *Physics* 254 A 24-33. On imagination as motion cf. *De Anima* 428 B 10 ff.

<sup>56</sup> *Physics* 239 B 9-240 A 18.



any time in its course it is in an indivisible instant in which there can be no movement, and 4) the stadium which illustrates the argument that a given time is equal to twice itself by showing that two equal series of points passing each other with equal velocities but in opposite directions and passing a third equal series which is at rest must traverse in the same time twice the number of points in each other as in the series at rest. These arguments Aristotle assumes to be directed against the possibility of motion as such,<sup>57</sup> and his resolution of the paradoxes takes the assumptions as Zeno's own and tries to show that motion is possible because these assumptions are unwarranted. In the *Dichotomy* Aristotle first answers that both time and space are equivalent in that both are infinitely divisible potentially so that the time in which a given space is traversed is infinite in the same sense in which that space contains an infinite number of points.<sup>58</sup> This explanation is supposed to be a sufficient answer to the *Achilles* also.<sup>59</sup> The *Arrow* he refutes by denying that time is composed of discrete instants,<sup>60</sup> and in the *Stadium* he explains the paralogism as due to the false assumption that a body of a given size and speed will pass a body at rest and in motion in equal times, for Zeno assumes that the constituent elements of the moving bodies will be parallel for the same length of time as they are parallel to the points they pass in the body at rest.<sup>61</sup> The *Arrow* as Aristotle presents the argument and answers it shows that Zeno was aware that the divisibility of time is parallel and equivalent to that of space;<sup>62</sup> although Aristotle still insists that the first two arguments overlook this fact and that consequently his first solution is sufficient for these paradoxes as stated, he admits that it is not a final answer, since the diffi-

<sup>57</sup> Although he does not directly say so in the *Physics*, his passing references to the arguments show that this was his interpretation. Cf. *Anal. Pr.* 65 B 18-19, *Topics* 160 B 8-9, *Soph. Elench.* 172 A 8-9, 179 B 20-21.

<sup>58</sup> *Physics* 233 A 21-B 15.

<sup>59</sup> *Physics* 239 B 11-29.

<sup>60</sup> *Physics* 239 B 30-33.

<sup>61</sup> *Physics* 240 A 1-18.

<sup>62</sup> See also V. Brochard, *Études de Philosophie ancienne et de Philosophie moderne*, pages 6 and 9.

culties raised in connection with space also apply to time. The true solution, he says, is that a line contains an infinite number of points as a given time contains an infinite number of instants only potentially, that if a continuum is divided by the actualization of any of these points it ceases to be a continuum, and that a continuous motion traverses an infinite number of points or instants only accidentally, for it is only accidentally that a line contains an infinite number of sections, its essence being continuity.<sup>63</sup> But this answers Zeno only by admitting his contention. The statement of Plato<sup>64</sup> supports the interpretation which the paradoxes themselves suggest, namely that Zeno was not trying to prove that motion is impossible because continuity consists of multiple parts but that, if continuity consists of parts, if it can be analyzed into discrete quantities or synthesized from them, motion is impossible. These four arguments form a dilemma presented to the pluralists which corresponds to the mathematical dilemma quoted by Simplicius<sup>65</sup> and has the same purpose as the argument concerning space.<sup>66</sup> All the extant arguments of Zeno are directed to the same end, by demonstrating the inconsistencies of a materialistic pluralism to prove that continuity is uncomposite and so that Being is unique.<sup>67</sup> In so far then as Aristotle believes that the continuous does not consist of separate moments he mistakes his opponent, for he is arguing against Zeno's adversaries rather than against Zeno.<sup>68</sup> There is still another argument of

<sup>63</sup> *Physics* 263 A 4-B 9.

<sup>64</sup> *Parmenides* 128 D 2-6.

<sup>65</sup> Simplicius, *Phys.*, 141, 2-8; cf. *ibid.*, 139, 5-8. See also *Metaphysics* 1001 B 6-10, where Aristotle misunderstands Zeno's argument (cf. page 40, note 156 *supra*) against the construction of continuous lines, etc., from indivisible, that is infinitely small, units (cf. Simplicius, *Phys.*, 139, 9-19).

<sup>66</sup> *Physics* 209 A 23-26; see page 145 *supra*.

<sup>67</sup> See Brochard, *op. cit.*, p. 20; A. Koyré, "Bemerkungen zu den Zenonischen Paradoxien," *Jahrbuch für Philosophie und Phänomenologische Forschungen*, V (1922), pp. 603-4.

<sup>68</sup> In *Metaphysics* 1069 A 12-14 Aristotle says that from his explanation of the successive and the continuous it follows that a point and a unit are not the same thing. Ross thinks this is an attack on Zeno because Zeno is said to have called the point τὸ ἐν (Simplicius, *Phys.*, 99, 11); this, however, he did only to deny the identification (Eudemus *apud* Simplicius, *Phys.*, 97, 12-16). The



Zeno's relating to continuity which Aristotle opposes; Zeno, he says, falsely concludes that any part of a measure of millet must make a sound in falling if the whole measure makes a sound.<sup>69</sup> For Aristotle force is not continuous,<sup>70</sup> and the air set in motion by the bushel of grain, since it is moved by the bushel as a whole, may not be affected in any degree by a part of the bushel, for the force of the whole cannot be divided and attributed to all the parts since in the whole the parts exist only potentially. The conclusion of Zeno, as represented in this passage, is that any part of a grain of millet however small must make a sound in falling. In the quotation given by Simplicius Zeno forces this conclusion on Protagoras by getting him to admit that the sound must vary directly with the size of the body making the sound and that any part of a grain bears some proportion to the size of the whole heap. It is unlikely that Zeno himself believed that any part of a grain would make a sound; and it is certain that he did not accept the premise, for that a body can be constructed of least parts whether finite or infinitely small is precisely the thesis against which all his arguments were directed. This paradox, then, was a dilemma of the same nature as the paradoxes concerning motion; his adversaries had either to admit the apparent absurdity of forces and sounds corresponding to infinitely minute bodies or abandon their theory of the composition of con-

terminology, then, was that of his adversaries. Philoponus thinks Aristotle has the Pythagoreans in mind; and Ross, admitting that this may be so, refers to *Metaphysics* 1080 B 19 (cf. 20-21), 1083 B 14. It is probable that here, as in the matter of the paradoxes, Aristotle has taken the premise of Zeno's argument for Zeno's own and intends to attack Zeno where he is really attacking those against whom Zeno argued.

For the curious inconsistency in Aristotle's proof of his thesis here see Ross's *Commentary*, volume II, p. 346.

<sup>69</sup> *Physics* 250 A 19-25. Simplicius (*Phys.*, 1108, 19-28) quotes the argument as a dialogue between Zeno and Protagoras, and for that reason Burnet (*E. G. P.*, p. 312, n. 4) thinks it unsafe to attribute the argument to Zeno himself. Even if the quotation of Simplicius is from a later writing, however, it is possible that the argument itself was original with Zeno.

<sup>70</sup> *Physics* 250 A 16-19; cf. Carteron, *La Notion de Force dans le Système d'Aristote*, pp. 21-22.

tinuity.<sup>71</sup> Although Zeno would certainly have opposed Aristotle's own solution of the difficulty, Aristotle is clearly wrong in supposing that the assumption of all these arguments, the composite nature of the continuous, was subscribed to by Zeno himself, whose objection to Aristotle's solution must have been precisely that, while it excludes a synthesis of continuity, it admits an analysis into "potential parts" which in fact destroys the unity of the Real.<sup>72</sup>

The investigation of the nature of continuity and the relationship of Zeno's arguments thereto lies outside of this study; but there are certain special criticisms made by Aristotle which must be examined. The first objection to the *Dichotomy* and the *Achilles*, that the two senses of infinity are confused and that, if the time as well as the distance be thought of as equally infinite in potency of division, Zeno's difficulty is resolved, not only is no final answer (as Aristotle later admits) but is not even a valid dialectical argument. The course of the two arguments depends upon the axiom that any two continua, whether spatial or temporal, if they consist of an infinite number of points or moments, are equally inexhaustible; to say that the spatial points and temporal moments are simultaneously exhausted does not meet the difficulty at all.<sup>73</sup> It is just the assumption that any finite space and any finite time contain an infinite number of elements that necessitates the conclusion. The *Stadium* wins only Aristotle's disdain for assuming that a body with a given velocity takes as long to pass an object at rest as it does to pass one moving with equal velocity in an opposite direction. But here again the argument is misinterpreted because the assumption against which Zeno was arguing

<sup>71</sup> A heap of grain is not a continuum, and Zeno would not have confused it with one; but that lends sharpness to his argument, for to his way of thinking his adversaries represented continua as being in fact discontinuous aggregations. If they had admitted the existence of an infinite range of sound below the level of audibility as Archytas later did (Archytas, *fragment* I, page 332, 3-5, Diels), this argument could not have served Zeno's purpose. Protagoras, however, could not admit the existence of "inaudible sounds."

<sup>72</sup> Cf. Brochard, *op. cit.*, p. 4 and pp. 13-14 with the quotation of Spinoza's *Ethics* I, 15, schol.; Koyré, *op. cit.*, pp. 615-17.

<sup>73</sup> Brochard, *op. cit.*, pp. 9-11.



is overlooked. The *Arrow* had proved that a continuum cannot consist of points because there can be no motion in the indivisible point and moment in which the moving object finds itself at any time. If, however, motion from point to point be assumed, the *Stadium* argues that, although there is a one to one correspondence between the elements of any section of time and any extent of space, in one indivisible moment a single point must occupy two positions, that is must pass two points. But, since point corresponds directly to moment, two such moments are required for such a motion. Consequently, one moment is equal to two.<sup>74</sup> This argument develops that of the *Arrow* just as the *Achilles* develops the *Dichotomy*; and, as the answer to the two latter is one and the same, so Aristotle's remark concerning the *Arrow* is the only one valid for the *Stadium*, namely that the assumption that time consists of instants is false. There remains only the question whether Aristotle's conception of the continuous solves the difficulties

<sup>74</sup> The paradox can be stated in various ways. Brochard says (*op. cit.*, pp. 8-9) "in the indivisible instant two positions were occupied by the moving bodies. But in that case the instant is no longer indivisible. In other words it is impossible to conceive of an indivisible instant such that one cannot . . . find . . . a movement which divides it. . . . To say that the instant is divided into two equal parts is to say, by hypothesis, that it is double itself." The argument may be so stated as to draw the same conclusion with regard to spatial points. The purpose of the paradox may be brought out perhaps more clearly by stating it in a different fashion but with the conventional diagram:

$$\begin{array}{cccc} A^1 & A^2 & A^3 & A^4 \\ B^4 & B^3 & B^2 & B^1 \\ & C^1 & C^2 & C^3 & C^4 \end{array}$$

If the two bodies B and C move with equal speed in opposite directions, when B<sup>1</sup> and C<sup>1</sup> are in line they will have moved one point in one instant (for movement is from point to point and moment to moment); but they will then occupy a point intermediate between A<sup>2</sup> and A<sup>3</sup>. The points of A, as well as of B and C, are contiguous, as are the moments of motion from A<sup>2</sup> to A<sup>3</sup>. Then between any two contiguous points and moments, if space and time consist of indivisible elements, motion requires that there be another point and moment. If now in a single moment B<sup>2</sup> and C<sup>1</sup> be brought into a line with A<sup>2</sup>, the point intermediate between A<sup>2</sup> and A<sup>3</sup> must have been passed by both B<sup>1</sup> and C<sup>1</sup>, so that the movement from A<sup>2</sup> to A<sup>3</sup>, if A<sup>2</sup> and A<sup>3</sup> represent contiguous points, requires two moments for passage from point to point; and, if A<sup>2</sup> and A<sup>3</sup> represent contiguous moments, two points were passed in one moment.

raised by Zeno's arguments. Unwittingly, as has been shown, he is at one with the Eleatic philosopher in denying that continuity can be constructed of elements whether finite or infinite; but he still insists that the continuous line contains *potentially* an infinite number of sections and that the moving object traverses an infinite number of elements in time and space, although it does so not absolutely but *per accidens*.<sup>75</sup> Such a distinction was unknown to Zeno; but, had he heard of it, he would probably have rejected the explanation on the ground that Reality loses its uniqueness and ceases to be a whole if divisible even in thought.<sup>76</sup> Aristotle's own doctrine of the priority of actuality<sup>77</sup> might have been turned against him to show that if he asserted the potential existence of an infinite number of points in the line he must concede the actual existence of an infinite number of elements in continuity.<sup>78</sup> Whether or not the Aristotelian explanation of continuity is sound and sufficient, the analysis of Zeno's arguments mistakes their purpose, and the specific criticism of them lacks depth and appropriateness.<sup>79</sup>

<sup>75</sup> *Physics* 263 A 27-B 9.

<sup>76</sup> Cf. Parmenides, *fragment* VIII, 22-25; Simplicius, *Phys.*, 138, 3-13.

<sup>77</sup> Cf. *Metaphysics* 1049 B 4-1051 A 2. In 1051 A 22-33 the potentially existing mathematical relations are said to be discovered only by their actualization. If this actualization be the result of the prior activity of thought, the contradiction is still not resolved; the continuous as consisting of an infinite number of elements is as impossible *in intellectu* as *extra intellectum*.

<sup>78</sup> So Koyré (*op. cit.*, pp. 618-619) argues for the actual prior existence of the infinite.

<sup>79</sup> Following the examination of Zeno's paradoxes, Aristotle refutes an argument which on the basis of the law of contradiction denies the possibility of change (*Physics* 240 A 19-29). That argument was probably Megarian (see page 89, note 378 *supra*). Immediately thereafter (*Physics* 240 A 29-B 7) Aristotle mentions an argument according to which circles and spheres are in motion and rest at the same time since the parts and the whole of such bodies when in motion are for a time in the same place. Against this Aristotle contends that the parts are continuously changing their positions and that the circumference of the whole is likewise constantly changing, the circumferences drawn from any two points being only accidentally the same. The thesis here combated is given among the arguments on motion by Sextus Empiricus; twice he says that it was used to overthrow the paradox of Diodorus Cronus, for those who advanced it thought thereby to prove against him that an object can be in motion



Against the theory that there is no rest Aristotle appeals to the experience of the senses as sufficient refutation; we see that the same thing is now at rest and again in motion, which is evidence enough not only that not everything is in motion but also against the possible modification of this thesis which would attribute unceasing motion to some things and continual rest to others.<sup>80</sup> Moreover,<sup>81</sup> since nature is a principle of motion and rest,<sup>82</sup> to deny the possibility of rest is to come to the same

in the place in which it is (Sextus, *Pyrrhon. Hypotyp.*, III, 71-72; *Adv. Math.*, X, 93-94). But elsewhere he says the paradox was advanced against those who defined motion as *μετάβασις ἀπὸ τόπου εἰς τόπον* (Sextus, *Adv. Math.*, X, 50-51). This definition of locomotion is that of Aristotle (*Physics* 226 A 32-35 and *Topics* 122 B 26-36 [where *ἡ κατὰ τόπον κίνησις*, i. e. *τόπον ἐκ τόπου μεταβάλλειν* is called the genus of which *φορά* strictly is a species]; Aëtius, I, 23 [*Doxographi Graeci*, p. 319, 12-15]). It seems, then, that the paradox under discussion was first advanced against Aristotle's definition of motion, and this is his answer to it. Those who advanced the paradox probably used his definition of rest also (cf. *Physics* 239 A 26-29; N. B. *χρόνον τινὰ καὶ αὐτὸ καὶ τῶν μερῶν ἕκαστον* and *χρόνον τινὰ . . . καὶ αὐτὰ καὶ τὰ μέρη* of the paradox, *Physics* 240 A 31-32) and this may be the kernel of truth in Alexander's statement (Simplicius, *Phys.*, 1022, 15-22). The paradox would then have been used a second time against Diodorus. Its origin was, however, probably Megarian since it clearly was meant to involve in a contradiction the explanation of motion, and it seems to have influenced the definition of motion given by Chrysippus (Arius Didymus, *Epitome*, 22 [*Doxographi Graeci*, p. 459, 11 ff.], cf. Sextus, *Adv. Math.*, X, 52, *Pyrrhon. Hypotyp.*, III, 64 where it is made clear that the *κατὰ μέρος* of Chrysippus' definition was intended to cover the case of the sphere).

<sup>80</sup> *Physics* 254 A 33-B 4. (In *Physics* 265 A 2-4 those who asserted that all sensibles are in constant motion are called *φυσιολόγοι*.) Although Aristotle may have included the Atomists among the group that posited continual flux of all physical objects, as Alexander believed (Simplicius, *Phys.*, 1196, 10 ff.), the words, *πεῖν γὰρ φασιν αἰεὶ καὶ φθίνειν* (*Physics* 265 A 6), show that he meant chiefly Heraclitus and the so-called Heracliteans (*Topics* 104 B 21-22, *De Caelo* 298 B 29-33; cf. Plato, *Theaetetus* 179 E-180 A, *Cratylus* 440 C), although it is not impossible that he included Plato himself (cf. *Metaphysics* 987 A 32-B 1, 1078 B 12-17). The modification might have been suggested by Plato's theory as interpreted in the last passage of the *Metaphysics*; but, since consideration of mobility is here restricted to physical objects, it was probably set down merely to exhaust all possible theories (Simplicius, *Phys.*, 1206, 3 ff. and the analysis of all possible explanations, *Physics* 253 A 24-30). A particular form of this third theory is Aristotle's own doctrine (*Physics* 253 A 28-32).

<sup>81</sup> *Physics* 253 B 6-9.

<sup>82</sup> *Physics* 192 B 13-23, cf. page 155, note 52 *supra*.

result as does the theory that denies motion, namely to doubt the existence of nature. Still, this thesis is not so obviously destructive of physical investigation as that which says that there is no motion.

Those who say that everything is in motion always, though our senses fail to perceive the movement, are not explicit about the species of this motion, whether it is one or all kinds in which all things are involved.<sup>83</sup> Aristotle undertakes to show, however, that their statement is not true of any of the three types of motion.<sup>84</sup> The growth, the decay, the altered object can be divided into an infinite number of parts; but the alteration itself cannot since it is instantaneous,<sup>85</sup> and, as a given quantity of water may wear away a certain amount of rock in a given time while a part of that water would never have any effect, the mere divisibility of the affected object does not require that one posit continuity of destruction.<sup>86</sup> As for spatial movement, these philosophers must have seen that a rock falls to the ground and remains there. Since all things remain necessarily in their proper places and are moved from them only by constraint, all things cannot be in motion spatially. Furthermore, growth and decay and qualitative alteration are not continuous but have a middle term at which there must be rest, for they are motions from contrary to contrary.<sup>87</sup> And of spatial motion only circular translation is continuous;<sup>88</sup> consequently in all but circular motion there must be a break at which there is no motion; and, apart from this one kind of translation, all change, being discontinuous, implies rest.<sup>89</sup>

The arguments which proved that not everything can be at rest or in motion are enough to refute the suggestion that some things are always at rest and the others always moving.<sup>90</sup> Speci-

<sup>83</sup> *Physics* 253 B 9-254 A 1. Cf. Plato, *Theaetetus* 181 D-E.

<sup>84</sup> For the three kinds cf. *Physics* 225 B 5-9. In *Physics* 265 A 4-6 Aristotle says alteration was particularly meant by those who said all things are in motion. This he deduces from their statement that "all things are in flux and decay" and from the "fact" that for them genesis and destruction were alteration (cf. pages 54 ff. and 105 ff. *supra*).

<sup>85</sup> See page 90, note 379 *supra*.

<sup>86</sup> See pages 158 (note 70)-159 *supra*.

<sup>87</sup> Cf. *Physics* 261 A 31-B 26.

<sup>88</sup> *Physics* 264 B 9-28.

<sup>89</sup> *Physics* 265 A 2-12.

<sup>90</sup> *Physics* 254 A 3-15.



fically, unless it is possible for a body to be put in motion from a previous state of rest, that is unless it can be moved out of its proper place, there will be no movement under constraint, no growth, no genesis, no destruction, for becoming requires a goal of movement and passing away an origination of it.

Motion for Aristotle is the actualization of the potential *quâ* potential;<sup>91</sup> it cannot be the object either as already actualized or as still completely potential, but it is just this process, that is the actualizing of the potential as such. Some evidence for the validity of this view, Aristotle believes, is furnished by those who defined motion as "otherness," "inequality," and "non-Being."<sup>92</sup> These terms do not define motion whether as the mobile object or as the termini of movement, for none of them does move and, as motion takes place between opposites, to consider them termini is to involve their contraries with them in the definition; but the use of these terms is due to the feeling that movement is something indefinite and all such indefinite principles were placed in the second series of opposites. The mention of this table shows that Aristotle means to attribute this definition of motion to the Pythagoreans,<sup>93</sup> but the terms themselves seem to refer to Plato;<sup>94</sup> and evidently the passage as a whole is a criticism of both. But it affords no evidence for the hypothesis that Plato's account of motion is truly Pythagorean, for the inclusion of movement in the "second series" points to nothing more profound than the observation that what is changing is undefined; there is here no more evidence for a Pythagorean theory of motion than there is for an analytical geometry in the fact that "the crooked" appears in the series of the infinite. Plato's short account in the *Timaeus* is, on the other hand, a genuinely physical theory of motion<sup>95</sup> of

<sup>91</sup> *Physics* 201 A 9-B 15.

<sup>92</sup> *Physics* 201 B 16-202 A 3. This passage is repeated in a slightly compressed form in *Metaphysics* 1066 A 10-26.

<sup>93</sup> In the table given in *Metaphysics* 986 A 22-29 as the set of principles adopted by Alcmaeon and the Pythagoreans motion, or rather "the moved," is in the column headed by "the infinite."

<sup>94</sup> See Plato, *Sophist* 256 D, *Timaeus* 57 E; cf. Eudemus *apud* Simplicius, *Phys.*, 431, 8-16.

<sup>95</sup> All motion, all change depends upon a disturbance of equilibrium. The

which Aristotle here takes no cognizance, because he has his own reason for referring to it. This feeling of the indefiniteness of motion, he says, is due to the fact that motion is neither the potentiality nor the actuality of existing things. It is, then, a confirmation of his own theory.

Every individual motion, every potentiality in process of actualization, requires a preceding motion as its generating cause.<sup>96</sup> The medium of motion is, consequently, a chain of mobile bodies, contiguous or consecutive, each being moved by another and, set in motion itself, imparting motion to that next to it.<sup>97</sup> Since sensation is the result of motion,<sup>98</sup> then, and there can be no spatial disjunction of mover and moved,<sup>99</sup> Aristotle is able to attack certain earlier theories of sensation as inconsistent with the true explanation of motion. Democritus had said that if the interval between the eye and the visible object were empty "an ant on the vault of heaven would be perfectly visible."<sup>100</sup> But, Aristotle objects, a color placed in direct contact with the eye is not seen; hence it appears that an intermediate body is necessary which, set in motion by color, itself affects the organ of vision and that this motion and so the medium of motion must be continuous.<sup>101</sup> Consequently sight without an intermediate body would be impossible. "Simi-

passage in the *Sophist* is rather logical; there motion is cited merely as an example of a concept which, being other than Being, both is and is not, i. e. "is not Being" as opposed to "is non-Being."

<sup>96</sup> *Physics* 255 B 31-256 A 3.

<sup>97</sup> *Physics* 242 B 24-29, 266 B 27-267 A 18.

<sup>98</sup> *De Anima* 416 B 33-35.

<sup>99</sup> *Physics* 243 A 3-10, 244 B 10-245 A 11, *De Somniis* 459 A 28-B 7.

<sup>100</sup> *De Anima* 419 A 15-21. Democritus evidently did not hold to the simple theory that the effluences themselves entered the eye. The effluences seem to have shaped the air in their path; this air then entered the eye as the "image" which was seen. Cf. Theophrastus, *De Sensibus*, 50 (*Doxographi Graeci*, p. 513, 17-27). Aristotle, too, says that Democritus explained sight by an "imaging" of the object (*De Sensu* 438 A 6). On this theory, the shaping of the air might not truly represent the form of the effluence; and this would cause blurred and distorted images in the eye, whereas, if there were no intermediate air, the effluences themselves would form the image.

<sup>101</sup> *De Anima* 419 A 12-15.

larly, all who say that colors are effluences from bodies and so explain sight, since they reduce sensation generally to touch, would better have explained sensation as a motion set up in the medium by the sensible object.<sup>102</sup> Democritus' use of effluences to explain dreams is likewise and for the same reason unnecessary.<sup>103</sup> Furthermore, this explanation of motion refutes of itself the earlier physical philosophers who said that color depends for its existence on sight and flavors on taste.<sup>104</sup> It is true that the sensible as actually sensible is contemporaneous with the sensation, but the object of sense existed as potentially sensible before the act of sensation. Now all the Presocratics, including subjectivists like Protagoras, admitted that sensation depended, at least in part, upon determinants existing independently of the sensitive subject. Aristotle's quarrel with them rests upon their contention that some or all of the sensible qualities are not primary and objectively existent in the external

<sup>102</sup> *De Sensu* 440 A 15-20. The passage is misplaced, probably from after τὴν σκέπην in 438 A 25. The theory is here attributed to "the ancients" by whom Aristotle means Empedocles (cf. 438 A 4-5; Empedocles, *fragment* 89; Plato, *Meno* 76 C; Theophrastus, *De Sensibus*, 7 [*Doxographi Graeci*, p. 500, 25-29]) and the Atomists (cf. 442 B 10-12, Theophrastus, *De Sensibus*, 73; Alexander, *De Sensu*, 56, 12 ff.), although he knew that the latter considered color only a secondary manifestation of the position of the atoms (*De Generatione* 316 A 1-2), so that for them color was not an effluence but the effect on the organ of sight of the position of parts in the effluence.

<sup>103</sup> *De Somniis* 464 A 5-11.

<sup>104</sup> *De Anima* 426 A 20-26. According to Simplicius the reference is to Democritus and his followers (cf. *De Sensu* 442 B 10-12); according to Philoponus Protagoras is meant. Plato, *Theaetetus* 156 A-157 B (especially 157 A: οὔτε γὰρ ποιοῦν ἐστὶ τι πρὶν ἂν τῷ πάσχοντι συνέλθῃ οὔτε πάσχον πρὶν ἂν τῷ ποιοῦντι) compared with *Metaphysics* 1047 A 4-7, where Aristotle tries to involve the Megarians in "the Protagorean thesis" on the ground that their doctrine that only the actual is possible amounts to saying that sensibles exist only when perceived, shows that he would here include Protagoras. But *Metaphysics* 1009 B 11-33 indicates that the Atomists, Empedocles, and, probably, Anaxagoras are also meant; and Aristotle's words, οἱ πρότερον φυσιολόγοι, implies that he is loosely charging all the earlier philosophers with the same attitude. The accusation derives from Plato's attempt in the *Theaetetus* to trace back the subjectivism of Protagoras to the physics of the Heracliteans and his half playful contention that this type of physics was much older than Heraclitus, was shared by all except the Eleatics, and always had implied subjectivism (cf. *Theaetetus* 159 C-160 D).

object. He admits that color as seen exists only during the particular act of vision; but color as visible must be prior to the actualization of it in sensation. Motion is actualized in the object moved, but this actualization implies an antecedent mover, for the motion is identical and simultaneous in action and passion but the subjects of action and passion are not.<sup>105</sup> This might conceivably be a valid answer to the subjectivists; but how does it prove against the Atomists the underivable existence of sensible qualities? Aristotle claims that sensation is not merely local motion but a specific kind of motion, alteration; <sup>106</sup> the actualization of an object capable of such change is due to the specific form present in the movent, so that the actualization of a quality cannot be due to a quantitative determination in the perceptible object.<sup>107</sup> If motion is the actualization of the potential as such, the sensible qualities must be primary and irreducible, independent of sensation and the sensitive subject.<sup>108</sup> That difficulty also which had been raised by some people, who claimed that no two persons could hear, see, or smell the same thing simultaneously, is resolved by Aristotle by means of this theory of motion.<sup>109</sup> The original

<sup>105</sup> *Physics* 202 A 13-21, 202 B 5-22.

<sup>106</sup> *De Anima* 415 B 24-25, 416 B 33-34, *Physics* 244 B 10-12.

<sup>107</sup> *Physics* 202 A 9-12.

<sup>108</sup> See pages 8-12 *supra*. In *Categories* 8 A 8-12 the sensible object is proved to be prior to sensation by the argument that the material elements of sensitive bodies are prior to those bodies. That is, the four elements are assumed to have differentiae which are originally qualitative. In Aristotle's system, in fact, the four qualities, hot, cold, moist, dry, are logically prior to the elementary bodies.

<sup>109</sup> *De Sensu* 446 B 17-26. The foundation of this objection is that one and the same thing (which the object of sense is taken to be) cannot be in two places at once. The same contention is attributed to Gorgias in his proof that two people cannot think about the same thing at the same time, "for the single object would then be two" (*De Melisso* 980 B 9-11). The argument there given proceeds by showing that, even if one thing could be in several places at once, it would still *appear* different if the subjects were not completely alike and in the same place; and the following sentence, concerned with sensation as it is, suggests that lines 11-14 are speaking of subjects of sensation and not of thought. In that case, it seems probable that, after proving that no two persons could *think* of one thing simultaneously, Gorgias used the same argument (that given by Aristotle in our passage) to show that two persons could not *perceive* a single object at once and then went on to argue that, even if the object was



moving cause of the sensation is one and the same, the motions set up by it are numerically different; but, if we recall that the form of the movent is actualized in that which is moved, it is clear that the numerically various motions, which are the immediate causes of sensation in the various subjects, are specifically one with one another and with the originating cause.

Such a series of motions, however, in which every mobile body is moved by another the motion of which has been actualized by a third movent, requires an ultimate originator of motion which, since Aristotle supports against Plato the impossibility of a self-moved mover, must itself be unmoved.<sup>110</sup> This unmoved mover can be no part of the universe Aristotle contends against those who made the poles of the universe the origin of its rotation.<sup>111</sup> They are justified in maintaining that no part

one, it would seem different since the percipient subjects are different. At any rate, the argument suits Gorgias who accepted the Empedoclean effluences as the cause of sensation (Plato, *Meno* 76 C-D) as it fits all theories which reduce all sensations to direct tactility.

<sup>110</sup> *Physics* VIII, chap. 5, 256 A 4-258 B 9.

<sup>111</sup> *De Animal. Motu* 699 A 12-27. Here it is argued that unless the prime mover be unmoved it would need an immobile support outside of the universe. The theory here criticized Farquharson believes to have been Pythagorean. He refers to *De Anima* 405 A 32, where Alcmaeon is said to have attributed continuous motion to the whole universe. Aristotle elsewhere says that the Pythagoreans made the earth revolve around a central fire (*De Caelo* 293 A 20-B 20); but he does not say whether this central fire rotated on its axis, as it should if the whole universe rotates. The distinctive features of the theory here presented are two; no part of the whole spherical universe can be at rest, and the celestial poles are through some power inherent in them the origin of the rotation of the universe. Now, the earlier Pythagoreans and Alcmaeon assumed that the earth rests at the center of the universe and that the planets have a motion opposite to that of the fixed stars (cf. Heath, *Aristarchus of Samos*, pp. 49-51); those who made the earth revolve around a central fire implied that this central fire is at rest (the epithets, *Διὸς πύργος*, *Διὸς θρόνος*, are sufficient evidence). Neither theory is consistent with the argument here reported, which is rather in verbal accord with what seems to be Aristotle's interpretation of Plato's *Timaeus* 40 C-D (cf. *De Caelo* 293 B 30-32, 296 A 26-27). The spherical universe, the rotation of the earth on its axis (which apparently is also the axis of the universe), and the origin of motion in a "divine power," all appear in the account of Ecphantus given by Hippolytus (*Refut.*, I, 15 [*Doxographi Graeci*, p. 566, 11-19]). Moreover, Ecphantus made this "divine

of the revolving sphere can be at rest lest its continuity be destroyed,<sup>112</sup> but the assumption that there is a power inhering in the poles Aristotle opposes on the ground that the poles, being limits, are points without mass and consequently have no substantial existence. In addition, the poles are two in number, while the motion of the cosmic sphere is single and, as such, must be the result of a single moving cause.<sup>113</sup> The myth of Atlas supporting the heavens Aristotle interprets as meaning that the heavens rotate about the celestial axis which rests upon the earth;<sup>114</sup> the immobility of the earth implied in this supposititious theory he approves, but he brings to bear against it the argument previously considered which would require that the earth be no part of the universe. Besides, the necessity of resisting the pressure of motion against it would demand that

power" resident in the "atoms" of which the world was constructed; and Aristotle's refutation here turns on the contention that the poles are mathematical points and so have no substantial existence. The atoms, which are the poles, might well have been called the causes of the sphere's revolution by Ecphantus. Whether Ecphantus was a person or a personage in a dialogue of Heraclides (cf. Heath, *op. cit.*, pp. 250-252), the theory must be posterior to Atomism. But Aristotle cannot be referring to the theory of Heraclides, for the latter made the fixed stars stationary (Simplicius, *De Caelo*, 519, 9-11; 541, 28 ff.) and Ecphantus, if he existed, must have done the same. Aristotle, then, is either referring to the *Timaeus*, which he interprets as giving motion both to the earth at the center and to all the heavenly bodies, or he knew of a theory which admitted the rotation of the earth but objected to Ecphantus-Heraclides that no part of the universe could be motionless. The implication of this argument is that the heavenly bodies have no free motion but are parts of a single continuous sphere, while the poles subsist as mathematical points without being parts of the material universe. That points had subsistence but no magnitude was the theory of Speusippus (cf. *Metaphysics* 1085 A 32-34, 1085 B 27-34 and contrast *Metaphysics* 1080 B 16-21); and, although next to nothing of his astronomical and cosmological doctrine is known, both the traditional connection of the present theory with Pythagoreanism and Heraclides and the chronological requirements make it plausible that the reference is to him or one of his students. Jaeger (*Aristoteles*, pp. 380 ff.) thinks that the theory is that of "ein Astronom eudoxischer Richtung wie Kallippos" and that it was meant to meet the requirements of the Aristotelian *πρῶτον κινεῖν*.

<sup>112</sup> Cf. *De Caelo* 290 A 5-7.

<sup>113</sup> Cf. *Physics* 259 A 13-20.

<sup>114</sup> *De Animal. Motu* 699 A 27-B 11; cf. *De Caelo* 284 A 18-22 (page 183 *infra*).



the earth, in order to remain stationary, exert a force equal to that exerted by the whole universe in motion and that which moves it; and, since this is impossible, the universe cannot be moved by anything within itself.<sup>115</sup>

The further evidence for the necessary existence of a prime mover apart from the physical universe, evidence which at the same time determines the necessary character of this mover, is the occasion for criticism of previous cosmological theories, from many of which, however, Aristotle contrives to extract support for his own doctrine. The present existence of motion is sufficient evidence for the actuality of the prime mover; but, if potentiality be prior to actuality,<sup>116</sup> the prime mover would at some time have passed from potency to actuality. To this

<sup>115</sup> The inertia of the body at rest is thought of as counter-pressure (cf. *De Animal. Generatione* 768 B 19) and the action of one body upon another depends upon the relative size of the two (*De Caelo* 275 A 7-10). On the relative size of the earth and the universe cf. *De Caelo* 298 A 19; *Meteor.* 340 A 6-8, 352 A 27-28. On the relationship of the present passage to Aristotle's dynamics see Carteron, *La Notion de Force dans le Système d'Aristote*, notes 608 and 74. The importance of the relative force of the motor and that set in motion is used by Aristotle to explain the cause of low-pitched and high-pitched voices (*De Gen. Animal.* 786 B 25-787 A 22). He objects to the explanation given by some people that the quantity of air set in motion determined the pitch, pointing out that a high voice may be loud and a deep voice soft. Loudness depends upon the absolute quantity of air set in motion; but the difference of pitch between two voices depends upon the relative mastery they have over the air to be moved. If the force of the movent surpass the force of the air, a large amount is moved either swiftly or slowly at the will of the movent and the voice is consequently loud and high or loud and deep; but, if the force of the air surpass that of the movent, either a larger amount is moved than can be moved sufficiently to make a loud noise, so that the intensely slow motion of what is still, absolutely, a small amount results in a deep but weak sound or a very little is moved swiftly so that the voice is high but still weak. Platt (Oxford translation) has pointed out that the theory depends upon the equivocal meaning of *βαρύς* (= "deep" and "heavy"), for Aristotle defends his explanation by saying that what is moved slowly is heavy and much air moves slowly. The Atomists tried to account for variations in sounds by the *shape* of the atoms which reach the ear (Aëtius, IV, 19, 3; cf. Lucretius, II, 410-413), but probably they also stressed the quantity of air "fashioned" by the voice (cf. Theophrastus, *De Sensibus*, 55-56). Archytas, on the other hand, accounted for both loudness and pitch by the "force" of the breath (*fragment* 1).

<sup>116</sup> *Metaphysics* 1071 B 23-1072 A 9.

there is the objection that, had this mover ever been in a state of potency, there would have been the possibility that the universe of change should not yet exist.<sup>117</sup> The mythologists, who generate the universe from "Night,"<sup>118</sup> and the physical philosophers, who say that all things were together,<sup>119</sup> fall into the same absurdity, for they posit a commencement of motion without any actual cause of motion. Matter, however, cannot move itself, and the recognition of this fact caused Leucippus and Plato to posit the eternal actuality of motion; but Aristotle objects that their simple assertion is not enough, since they neither define this eternal motion nor assign a cause for it,<sup>120</sup> although from experience it is clear that motion is never random, for the direction of motion can always be traced to a definite cause. The primary motion must have a definite character, then, and so a definite cause; and this cause, the prime mover, must be an actual mover, must be actuality, since actuality is prior to potentiality.<sup>121</sup> Although the physical philoso-

<sup>117</sup> That the cause of the universe could not be chance is a conviction of Aristotle's (cf. *Metaphysics* 984 B 14-18, *Physics* 196 A 24-B 5; cf. page 250 *infra*) which is supported by the argument that chance and the automatic imply the priority of a final cause (cf. *Physics* 197 A 5-9, *Metaphysics* 1065 B 1-4); this means that, if the world came to be at a given moment, there must have been a cause in consequence of which it *necessarily* came to be at that instant and at no other (cf. *De Caelo* 283 A 11-24).

<sup>118</sup> Cf. *Metaphysics* 1091 B 5-6; Hesiod, *Theogony* 116, *Works and Days* 17; Orpheus, *fragment* 12 (Diels); Musaeus, *fragment* 14 (Diels); Epimenides, *fragment* 5 (Diels); Acusilaus, *fragment* 1 (Diels). N. B. Night is not the first for Hesiod and Acusilaus, while Epimenides and Musaeus set up a duality of first principles.

<sup>119</sup> The principle of Anaxagoras is here extended as essentially that of all the physical philosophers (cf. *Metaphysics* 1069 B 20-23 where the principles of Anaxagoras, Anaximander, Empedocles, and Democritus are all identified and made equivalent to Aristotelian matter; cf. page 57 *supra*), although in *Metaphysics* 1072 A 4-7 Anaxagoras, Empedocles, and Democritus are cited as authorities for the priority of actuality and in *Physics* 250 B 15-251 A 5 they are separated from the Ionians (cf. page 173, note 128 *infra*). The implication that they, like the Ionians, merely took it for granted that matter moves is patently false; but it is just as false to imply that Leucippus first assumed the eternity of motion.

<sup>120</sup> This charge against the Atomists is repeated in *Metaphysics* 985 B 19-22, *De Caelo* 300 B 8-16.

<sup>121</sup> In the individual potency precedes actuality (*Metaphysics* 1051 A 32),



phers have just been criticized for assuming a beginning of motion without any cause and the Atomists for positing eternal motion without assigning cause or definition, Aristotle now appeals to the authority of Anaxagoras, Empedocles, and Leucippus for support of his doctrine of the priority of actuality; the *voûs* posited by Anaxagoras is actuality,<sup>122</sup> he claims, as is the double principle of "Love" and "Strife"<sup>123</sup> set up by Empedocles, and those who say motion is eternal obviously mean that actuality is prior.<sup>124</sup> Consequently, "Chaos" or

but that very fact proves that there must be an actuality prior to all potency since the particular potency is actualized by a cause which is itself actuality (*Metaphysics* 1049 B 4-1050 B 2; cf. *Physics* 202 A 9-12, and 251 A 8-28 where the eternity of motion is proved by the same argument).

<sup>122</sup> But in *Metaphysics* 1071 B 27-29 he obviously criticizes Anaxagoras for failing to endow his moving cause with prior actuality (cf. *De Caelo* 301 A 11-13, *Physics* 250 B 24-26). Aristotle's interpretation of the *voûs* of Anaxagoras varies to suit his immediate purpose. In *Physics* 256 B 24-27 he identifies it with his own "unmoved mover," insisting that it was this that Anaxagoras meant by saying it was "unmixed" and "ruler over all." To this interpretation he tries to lend plausibility by introducing into the quotation the adjective "impassive." Anaxagoras, of course, had no conception of an immobile mover (cf. *fragment* 13 and Heidel, "On Certain Fragments of the Pre-Socratics," *Proceedings of the American Academy of Arts and Sciences*, XLVIII, p. 731; Plato, *Cratylus* 413 C).

In *De Anima* 429 A 18-22, 429 B 23-25, this phrase, "ruler over all," is reinterpreted to mean "capable of knowing" in order that Aristotle may find in it his own theory of mind as the potentiality of becoming all forms and imply that it was to fulfil the necessities of this condition that *voûs* was called "pure and unmixed." Here against the adjective "impassive" is added.

In *Metaphysics* 1075 B 8-10 the principle of Anaxagoras is said to be an efficient cause, and his theory is criticized for lacking a final cause of motion.

<sup>123</sup> Yet in *Metaphysics* 1075 B 2-4 "Love" is said to be a material principle equivalent to the four "roots" and a part of the whole mixture; and in *Metaphysics* 1004 B 33 "Love" and "Strife" are treated as terms for the two opposite states of the universe (cf. pages 47-48 *supra*).

<sup>124</sup> Aristotle does not, perhaps, mean that they posited eternal motion because they clearly saw that actuality is prior to potentiality. At any rate, he claims that it was ignorance of the nature of this distinction which led astray all the Presocratics and caused the Eleatics to deny the possibility of change (cf. e. g. *Physics* 191 B 27-34).

The same desire to find in his predecessors justification for his doctrines leads him to prove at great length that all previous philosophers support his theory of the priority of locomotion to all other types of movement. In *Physics* 265

"Night" did not exist for an infinite time, but there were always the same things either passing through cycles of change or somehow maintaining the identity of the world in the eternity of motion.

This refutation of all theories that posit a beginning of motion is for Aristotle, however, secondary, the answer prepared for a possible objection to his original proof of the eternal actuality of the prime mover.<sup>125</sup> That proof derives from the necessity of eternal and continuous motion,<sup>126</sup> a necessity the proof of which is *eo ipso* a refutation of Presocratic cosmogonies. All who concern themselves with natural process simply admit motion as a fact;<sup>127</sup> but those who suppose that there is an infinite number of worlds, some of which are being generated and others destroyed, necessarily assume that motion is eternal, while those who say there is but one cosmos adopt concerning motion hypotheses which differ according as this cosmos is thought to be eternal or not.<sup>128</sup> Obviously, if the

B 17-32 he shows that the motion of the first principles of all who mention motion is spatial; the "Love" and "Strife" of Empedocles which separate and unite, the *voûs* of Anaxagoras which as prime mover separates, the atoms of those who say that motion is due to the existence of a void and who explain all other motions as the union and separation of these atoms, the compression and rarefaction of those who explain generation and destruction by means of this mechanism, all these are spatial motions.

<sup>125</sup> Cf. the transition, *καίτοι ἀπορία* (*Metaphysics* 1071 B 22).

<sup>126</sup> *Metaphysics* 1071 B 6-21: If motion is eternal and continuous, there must be an eternal circular motion, since only circular motion is continuous. This requires a movent that is eternally active; therefore, the essence of the movent must be actuality.

<sup>127</sup> *Physics* 250 B 15-252 A 5.

<sup>128</sup> According to Simplicius (*Phys.*, 1121, 5-15) Anaximander and the Atomists belong to the first class, Aristotle (and Plato) to those who posit a single eternal cosmos, and Anaximenes, Heraclitus, and Diogenes to those who say that there is always one world but that it is not the same throughout all periods. By the third class Aristotle, however, intends to designate all those and only those who assert that there may be some time past or future during which no world exists; this might cover three separate theories: 1) the world came into being and will pass away preceded and followed by no cosmos, 2) the world came into being preceded by no cosmos and will endure forever, 3) the world came into being preceded by a series of worlds generated and destroyed and will perish to be followed by a series of such worlds. To Empedocles is attributed



unique world is not eternal there must have been a moment when there was no motion; and the systems of Anaxagoras and Empedocles represent for Aristotle the only two possible descriptions of such a cosmological history.<sup>120</sup> That of Anaxa-

the third of these sub-types; Anaxagoras is apparently credited with the second (cf. the contrasted element in Empedocles' account: *καὶ πάλιν ἡρεμεῖν*. But see page 181, note 162 *infra*). The common characteristic of all three is that they imply the possibility of complete rest whether for an infinite or finite period of time; and consequently the system of Heraclitus cannot be included among them, even if Aristotle had thought that it provided for periodic conflagrations, as he probably did not (cf. page 29, note 108 *supra*). With regard to the number of worlds existing at any one time it is questionable whether the theories of Anaximander and Anaximenes should be separated (cf. *Doxographi Graeci*, p. 327 B 10, Burnet, *E. G. P.*,<sup>3</sup> p. 59, n. 1); it is natural that Anaximenes should have followed Anaximander in supposing that at any one time there exist an infinite number of worlds which have all been preceded by other worlds and will perish to be followed by still others (cf. Burnet, *E. G. P.*,<sup>3</sup> pp. 58-61, 78; Zeller-Nestle, *op. cit.*, I, 311, n. 4, 328, n. 2 [Nestle's additions]). This would set Anaximander and Anaximenes in the first class and mean that, according to Aristotle, they made motion eternal; and the hypothesis of eternal motion was evidently attributed to them by Theophrastus (cf. Simplicius, *Phys.*, 24, 24-25; 24, 31; 41, 17-19; [Plutarch], *Stromat.* 2 and 3; Hippolytus, *Refut.*, I, 6, 2). The remarks of Simplicius to this effect, however, are made in his commentary on *Physics* 184 B 15-18 where Aristotle says that all the physical philosophers who set up one principle used a material *in motion*; and the statement of Theophrastus was evidently a development of that remark and of the implication of the present classification. The interpretation was still further developed as appears from the report of Hermias (*Irris. Gent. Philos.*, 10) that the *principle* of Anaximander was eternal motion. But that Aristotle did not mean to include the Ionians here among those who said motion always existed is proved by a comparison of this passage with *Metaphysics* 1071 B 26-33 (cf. page 171, note 119 *supra*) where it is implied that Leucippus first said that motion is eternal. There Anaxagoras (and Empedocles, probably) are lumped with the earlier philosophers as though they, too, thought matter could move itself; here the Ionians are evidently accounted for by the general statement that all who were concerned with nature posited motion (lines 15-18). They simply said nothing further about it and so are not included in any of the special classes.

<sup>120</sup> Aristotle, then, believes that Anaxagoras held the theory of a single cosmos. Burnet, although he takes no notice of this passage and its implication, asserts that Anaxagoras like Anaximander and Anaximenes held the theory of innumerable worlds (Burnet, *E. G. P.*,<sup>3</sup> pp. 269-70). In this case all the evidence we have favors Aristotle against Burnet (cf. Zeller-Nestle, *op. cit.*, I, 1239). See page 181, note 162 *infra*.

goras represents the change from a state of rest which has lasted from eternity to a process of division and articulation as due to the motion initiated by intelligence; the theory of Empedocles, on the other hand, sets up alternate periods of rest and motion, "Love" moving all things to unity and "Strife" dividing the unity into multiplicity with periods of rest forming the intervals. This interpretation is correct in so far as it makes Empedocles assert alternate periods of rest and motion; but the lines which Aristotle quotes have no connection with this part of the theory, and he misinterprets them in order to get four periods, two of rest and two of motion, in each cycle.<sup>130</sup>

In either case an absolute initiation of motion must be

<sup>130</sup> He quotes *fragment* 17, 9-13 or 26, 8-12 (Diels) and then says *ἡ δὲ τὰδ'* must be understood as meaning *ἐνθὲνδε τὰ ἀλλάσσοντα*. Since we have the context of the passage, we can see that by *ἀκίνητοι* in the last line Empedocles meant that the continued existence of the four "roots" as such never changes and not any reference to periods of local rest. Plato (*Sophist* 242 E) implies only two periods in the cycle; and, although the period of motion admits analysis into two phases (that of the increasing dominance of "Strife" over "Love" and that of the gradual defeat of "Strife" by incoming "Love"), Empedocles probably did not think of these two phases as separated by a period of rest during which "Strife" has complete control (cf. Millerd, *On the Interpretation of Empedocles*, pp. 53-55; Zeller-Nestle, *op. cit.*, I, 971, n. 1 [Nestle's addition]). Evidently he said nothing at all about this moment, for otherwise Aristotle could have found better evidence than these four lines which have to be rewritten and read out of context to produce the meaning he desires. Once the two forces are conceived as contrary to each other in the Aristotelian sense, there must be two periods of rest in the cycle (cf. *Physics* 262 A 6-17). The length of the quotation shows that Aristotle was supporting an interpretation not universally accepted, and that must have been the notion that Empedocles recognized four periods; the ineptitude of the quotation is good evidence that the interpretation is wrong. (Von Arnim's notion [based on *τὸν μεταξὺ χρόνον*, *Physics* 252 A 9] that Aristotle accepted only two periods has no verbal support, as Millerd proves, *op. cit.*, p. 54, n. 1, and would moreover be impossible for him because of his analysis of "motion in a circle.") A similar misinterpretation occurs in *Physics* 252 A 7-8 where Aristotle takes Empedocles, *fragment* 26, 1 = 17, 29 to refer to the alternate action of "Love" and "Strife" as exclusive motors, whereas the line obviously concerns the four "roots" (cf. Simplicius, *Phys.*, 160, 14 ff.) and in *De Caelo* 295 A 29-32 where Aristotle assumes a moment of complete rest "when the elements had been separated by 'Strife'" (cf. p. 205 *infra*).



assumed, an instant at which, though there was no motion before, motion is actualized; and Aristotle uses two arguments to show that such an instant is inconceivable. 1) The object set in motion must have existed as mobile before its motion was actualized; and this object must somehow have previously come to be (in which case change and so motion of some kind preceded the assumed initiation of motion) or all the motive and mobile objects involved in the initial motion must have existed from eternity unmoved and unmoving. Such an assumption is absurd at sight;<sup>131</sup> but Aristotle seeks to show that, like its alternative, it really presupposes a movement prior to the initial motion. In the first place, the rest of potential motor and mobile must itself have had a cause, since an object comes to rest by privation of motion,<sup>132</sup> and this cause must have been a change, that is a movement, prior to the assumed initial motion. This argument, however, requires for its validity that the general term *ἡρεμία* be used only in the special sense he has given to it, namely the immobility of a naturally mobile body in the place, time, and manner in which it would naturally move;<sup>133</sup> this definition forces Aristotle to admit that not everything unmoved is at rest<sup>134</sup> and, further, to distinguish between "natural" and "constrained" rest.<sup>135</sup> Consequently, if the rest of the potential motor be thought of as "natural rest," it cannot be privation and does not for that reason presuppose a prior change.<sup>136</sup> Evidently for this reason

<sup>131</sup> According to Simplicius (*Phys.*, 1127, 28 ff.), absurd because there is no reason for eternal potentiality to be actualized at one moment rather than another. The more general statement, which Aristotle probably has in mind, is that such a notion assumes the priority of potentiality (cf. page 171, note 121 *supra*).

<sup>132</sup> Cf. *De Caelo* 286 A 22-28 where from the existence of earth, the characteristic qualities of which are supposed to be privative of those of fire, the existence of fire is proved *a fortiori*. How this proof depends upon the equivocal intention of the term, privation, can be clearly seen from Simplicius, *De Caelo*, 400, 10-23.

<sup>133</sup> Cf. *Physics* 226 B 12-16, 234 A 32-34, 239 A 13-14.

<sup>134</sup> Cf. *Physics* 221 B 12-14.

<sup>135</sup> Cf. *De Caelo* 295 A 5-10; *Physics* 230 B 10-231 A 17.

<sup>136</sup> Motion itself is not true actuality (*Physics* 201 B 27-202 A 3); and, if the four primary bodies attain complete actuality only in their proper places, their actuality implies rest and not preceding motion (cf. *De Caelo* 311 A 1-8

Aristotle does not press the argument from privation to prove that rest implies previous motion but turns the application to show that the actualization assumed as primary requires an antecedent change in the potential motor or mobile objects. If for a time they do not stand in effective relationship to one another and then at a given instant the one actually moves the other, this must be the result of a previous change in one or both or in the relationship, as when potential agent and patient are actualized as such by being brought into effective proximity. 2) An instant of initiation implies a moment preceding itself when all was at rest, and the instant is a limit at once of preceding time and of future time; consequently any given instant implies time existing infinitely before and after it.<sup>137</sup> But since time exists only as the numerable aspect of motion,<sup>138</sup> there must always have been motion as there was always time.<sup>139</sup> This argument from the concept of the instant as limit seems obnoxious to all the objections raised by Aristotle himself in regard to the arguments for infinite spatial extension.<sup>140</sup>

In like manner Aristotle argues that motion can never cease completely because the presumptive final movement will be found to imply a subsequent motion inasmuch as an object does not cease to be moved and mobile or moving and motive simultaneously. Presumably the meaning is that the loss of actual motion still leaves the potentiality of motion which of itself implies subsequent movement.<sup>141</sup> But it implies for Aristotle a *necessary* subsequent movement because the cessation of any actual motion still leaves in proximity potential motors

and Simplicius, *De Caelo*, 705, 12-24; *Physics* 212 B 33-213 A 5, 253 B 33-35). Aristotle's doctrine of proper natural place is inconsistent with his belief that motion is prior to rest as state to privation. He could, however, argue that, if the original state of rest was natural, the initiated motion must have been one of constraint. Yet such a motion implies a natural motion (cf. page 32 f. *supra*).

<sup>137</sup> Here Aristotle attacks Plato for positing a beginning of time (cf. *Timaieus* 38 B). All others, he says, say that time is ungenerated and by means of this assumption Democritus proved that not everything has come into being.

<sup>138</sup> Cf. *Physics* 219 A 30-B 32.

<sup>139</sup> Cf. *Metaphysics* 1071 B 6-10.

<sup>140</sup> *Physics* 208 A 11-22. See pages 22 ff. *supra*.

<sup>141</sup> Cf. Simplicius, *Phys.*, 1169, 29 ff.

and mobile objects, and of this phenomenon further movement is an unavoidable result. Since motion is the actualization of form in the mobile object under the influence of the movent and so, like the sensible qualities, is a definite characteristic of body, there is for Aristotle no possibility of a universal equilibrium of energy. Likewise, should one suppose these objects destructible, since destruction can occur only by the agency of another body, the agent must survive that which it destroys and be survived by its own destroyer.

These arguments form the proof for the eternity of motion and at the same time the refutation of the theory of alternate motion and rest; they are followed by a castigation of Empedocles, Anaxagoras, and Democritus for the insufficiency and inappropriateness of the reasons which they give for their theories of motion.<sup>142</sup> To say that "Love" and "Strife" are *necessarily*<sup>143</sup> present in bodies and move them in alternate periods with an interval of rest and to give as the reason for this only the statement that "this is the nature of things," as Empedocles seems to do, smacks of fiction. For all that, such an explanation, in that it attributes a certain order to nature, seems to Aristotle preferable to the type of theory represented by Anaxagoras. He, too, would probably find the reason for his single motor cause in "the nature of things;" but to say that after an infinite period of rest suddenly things were set in motion, besides offering no reason why any particular moment should have been taken as the time for this change, is to attribute to "nature" an essentially unnatural action. Infinity can enter into no proportion; but all order is proportion, and nature is the cause of order which is the characteristic mark of everything natural. What occurs "naturally," according to Aristotle, occurs constantly or, at least, with a definite order and proportion. The theory of Anaxagoras "splits nature in two," he feels, and makes it a realm of disorder. Therefore, because there is no conceivable relationship between the two periods posited by this theory, it falls short of that of Empedocles. But the latter fails to give any cause for his regularly

<sup>142</sup> *Physics* 252 A 5-B 5.

<sup>143</sup> Cf. Empedocles, *fragment* 30.

recurring periods and sets up an hypothesis without appeal to experience or demonstration. The essential nature of love and strife is not this periodicity; one may say that the essence of one is attraction and of the other repulsion and appeal to the experience of the attraction of men by love and the mutual repulsion of enemies,<sup>144</sup> but if one will add that these take place alternately he must bring similar evidence and specify cases. Moreover, there is need of further evidence still to establish the supposedly equal duration of the periods.<sup>145</sup>

In general, Aristotle proceeds, the mere fact that a thing is always so or always happens in a given manner is no explanation; Democritus, he says, referred natural causes to such a principle,<sup>146</sup> but, while first principles have no cause beside themselves, other eternal truths have causes apart from their eternity.<sup>147</sup> If there has always been motion, then, the cause of that motion should be investigated.

<sup>144</sup> This is the method Empedocles follows; cf. *fragment* 17, 21-24. A similar criticism of Empedocles' method precedes the objection that his theory takes no account of natural motion: It is not enough to say that "Love" and "Strife" set things in motion unless these names be used to designate two different forces the essential nature of each of which is a specific kind of motion; and in that case some kind of explicit hypothesis or proof must be given (*De Generatione* 333 B 22-26).

<sup>145</sup> Cf. the reasoning of Aristotle (*Metaphysics* 1072 A 9-18); the eternity and the periodicity of change require, besides a *prime* mover, a *primum* mobile and a third agent with double motion.

<sup>146</sup> Cf. the criticism of Leucippus and Plato (*Metaphysics* 1071 B 32-34). In *De Gen. Animal.* 789 B 2 Democritus is said to have referred natural phenomena to "necessity"; but what he meant by necessity appears from Aëtius, I, 26, 2 (*Doxographi Graeci*, p. 321 A 16) to be the motion and interplay of the atoms (cf. Aëtius, I, 25, 3: *κοσμοποιόν*; I, 26, 2; Diogenes Laertius, IX, 45). When here he is said to have bidden no research into the cause of the "constant," it is probable that Aristotle is extending his meaning of *αἰεί* and that he meant no prior cause for the continual motion of the atoms should be required. In that case he is merely stating Aristotle's own doctrine to the effect that first principles have no prior cause, although his conception of the first principles differs violently from that of Aristotle. (For Leucippus [cf. *fragment* 2] necessity meant only that every event has a definite cause.)

<sup>147</sup> For example, geometrical propositions: the sum of the angles of a triangle *always* is two right angles, but the cause of this fact is not its constancy but the essence of triangularity.



The possible arguments against eternity of motion and the evidence for them Aristotle outlines in order to show that none is valid.<sup>148</sup> In the first place,<sup>149</sup> since all change takes place between contraries which are the limits of that change, no movement can be eternal. The terminology of this argument shows that it derives from Aristotle's own theory of movement; he states the objection chiefly in order that from it he may proceed to the development of his astronomical theory. The second argument has two parts. We see that inanimate objects pass from complete rest to motion in an instant; unless we should deny that they are ever at rest or ever in motion, we must admit that motion comes into being.<sup>150</sup> This thesis is supported particularly in the case of living beings; we ourselves pass from rest to motion and the principle of that change is frequently within ourselves.<sup>151</sup> Inanimate objects move only by external stimulus; but living creatures set themselves in motion. One may argue, then, that, if this is true of one living being, it may be true of the universe because the animal is a microcosm; further, what happens in the universe may happen in the infinite.

The argument from the difference of motion in animate and inanimate bodies is generalized from Plato's proof that the soul is the source of all motion,<sup>152</sup> and the argument from microcosm to macrocosm is also Plato's,<sup>153</sup> but the application to the infinite and the use of the contention to prove the possibility of universal initiation of motion show that Aristotle is thinking of the material monists and Anaxagoras.<sup>154</sup>

<sup>148</sup> He intimates that no one presented these arguments as they stand (*Physics* 252 B 7-9: Δόξειε δ' ἂν ἐκ τῶν τοιῶνδε σκοποῦσιν ἐνδέχασθαι μάλιστα . . .).

<sup>149</sup> *Physics* 252 B 9-12.

<sup>150</sup> *Physics* 252 B 12-16.

<sup>151</sup> *Physics* 252 B 17-28.

<sup>152</sup> Plato, *Laws* 894 B, 894 E-895 B, 895 C, 896 A-B; cf. *Phaedrus* 245 C.

<sup>153</sup> Plato, *Politicus* 269 D, *Timaeus* 30 B, 37 C-D. Aristotle may have in mind also Democritus who seems to have argued from microcosm to macrocosm (*fragment* 34, cf. Aristotle, *De Part. Animal.* 640 B 33-34; Sextus, *adv. math.*, VII, 265); but Democritus could not have used the argument to support an initiation of motion in the atoms.

<sup>154</sup> Cf. *Metaphysics* 1071 B 27-31 (page 171 *supra*), *Physics* 205 B 1-24

To this last argument Aristotle answers that there are at all times many changes and motions in animals of which not the animal itself but its environment is the cause; these movements set in motion thought and conation which in turn produce locomotion of the whole creature.<sup>155</sup> That inanimate objects pass from rest to motion and back proves not that there may be an unique initiation of movement, but only that in individual cases there is an external motor now present and again absent; the phenomenon merely poses the question as to why some things are not always moving and others always at rest.<sup>156</sup> The first objection, Aristotle admits, is valid, but only if it be shown that no motion can be eternally continuous;<sup>157</sup> it is, in fact, from this argument that he constructs his world of motion, showing that only circular motion can be continuous<sup>158</sup> and primary;<sup>159</sup> and, finding such a motion in the sphere of fixed stars, he transmits through it the eternal influence of the unmoved mover to a world of eternal change.<sup>160</sup> The eternity of motion, then, establishes what is suggested by ocular evidence, namely that the sphere of the fixed stars has eternal circular motion; it could not have been generated and is not subject to destruction,<sup>161</sup> as some have maintained;<sup>162</sup> but,

(page 32 *supra*). It is possible that Anaxagoras, too, advanced the argument from the microcosm (cf. *fragment* 12: νοῦς δὲ πᾶς ὁμοίος ἐστὶ καὶ ὁ μείζων καὶ ὁ ἐλάττω and *Metaphysics* 984 B 15-16).

<sup>155</sup> *Physics* 253 A 7-21; 259 B 1-20.

<sup>156</sup> *Physics* 265 A 13-B 16.

<sup>157</sup> *Physics* 253 A 2-7.

<sup>158</sup> *Physics* 259 B 20-260 A 19.

<sup>159</sup> *Physics* 252 B 28-253 A 2.

<sup>160</sup> *De Caelo* 283 B 26-284 A 18.

<sup>161</sup> *Physics* 264 B 9-265 A 12.

<sup>162</sup> Aristotle here refers loosely to all his predecessors. In *De Caelo* 279 B 12-280 A 34 he makes a threefold distinction among them. They all held that the world was generated, but some thought it would also perish, some believed it would be immortal, and some it would continually pass through alternate stages of existence, such as we know it, and destruction, when it has some other constitution. The last theory he attributes to Empedocles and Heraclitus without distinction; but he argues that such a world would in fact be eternal, for the alternate states, being opposites, would arise by an ordered alteration of the elements and the resulting states themselves would not vary in character. So, the cosmos itself would not come to be and pass away; this could be said only of its individual states. He then argues against the possibility that the world once generated can be completely destroyed without subsequent regeneration,

as circular motion, it is continuous, without beginning or end, the source and limit of all other motions.<sup>163</sup> Since this motion is not subject to weariness for it is not a motion of constraint, there is no need of any external force to maintain the heavens. By this Aristotle means that the circular motion of the outer sphere is its own actuality and not the result of a complex of forces, so that—to use modern language—there is no resistance involved in the motion. It was ignorance of this, he says,

for, if it was once generated, there must have been an antecedent state from which generation by change was possible. Presumably, then, if destroyed, the world would once more find itself in this state which, by definition, is capable of giving rise to the cosmos again, for that antecedent state, since it is capable of change, could not have existed from eternity but must itself have been the result of generation. Since this argument, which presupposes the necessary reciprocal relation of change and contrariety, is phrased as if aimed at a theory which posited a single world and since Aristotle supposed Anaxagoras to have thought the world unique (cf. page 174, note 129 *supra*), it might seem that Anaxagoras is referred to here. But that would represent him as believing that the unique world would some day be destroyed. The name of Anaxagoras is included in a list given by Stobaeus of those who thought the cosmos perishable (Aëtius, II, 4, 6); but Simplicius testifies to the contrary (*Phys.*, 154, 29-31), and Aristotle elsewhere intimates that Anaxagoras thought the cosmic motion, once begun, would never cease (cf. page 173, note 128 *supra* and *Physics* 252 A 13: τὸ δ' ἀπειρον πρὸς τὸ ἀπειρον οὐδένα λόγον ἔχει). Anaxagoras himself, however, did not say clearly what he thought on this subject (cf. Eudemus *apud* Simplicius, *Phys.*, 1185, 9-15) which is presumptive proof that he did not think the cosmos perishable. In that case this cannot be a separate refutation of any one theory, since all who thought this world must perish held the theory of multiple worlds; it is rather a concluding generalization to show that, if the world be perishable, it is necessary to adopt a cyclical theory and consequently to admit that special phases of the cosmos, not the cosmos itself, are perishable. (The suggestion of Simplicius [*De Caelo*, 311, 7-21] must be rejected because Aristotle does not himself draw the conclusions which Simplicius does from *De Caelo* I, chapter 12.) Aristotle admits that the destruction of a single world seems more plausible if innumerable worlds be posited, but he suggests that it is useless to debate that form of the theory (the common doctrine of the Ionians and Atomists) since it will later appear that the cosmos must be unique. The greater part of the present passage (279 B 17-280 A 11, 280 A 28-34) is concerned with Plato and the Platonists. Cf. page 137, note 553 for rebuttal of presumable evidence in favor of the alteration of the cosmos.

<sup>163</sup> Here Aristotle draws rhetorical support for his conclusions from the traditional belief that the heavens belong to the gods; he interprets the tradition to mean that the heavens are immortal and so besem immortal divinities.

that caused ancient men to invent the myth of Atlas sustaining the heavens,<sup>164</sup> which they did for the same reason that some injected a spiritual necessity into the universe to sustain the bodies on high that they thought were earthy and so heavy;<sup>165</sup> but this is as false and unnecessary as the hypothesis of Empedocles according to which the heavenly bodies are maintained in their places only because the speed of their rotation overbalances their tendency to fall.<sup>166</sup>

At the celestial sphere, the *primum mobile*, Aristotle's dynamics collides with his doctrine of natural motion, for, if the natural motion of the fifth essence is circular translation and if this sphere has no potentiality implying the contraries of rest and motion, the influence of the prime mover upon it is gratuitous. Further, how can it have natural motion at all, if such motion is that from an alien place to the proper place of the body in motion? The sphere is *in* its proper place or, rather, not in place at all, since it itself is the place of the universe.<sup>167</sup> Yet, as from the eternal motion of the fixed stars Aristotle proves the necessity of an eternally actual motor, so he seeks to refute earlier theories concerning their composition by insisting that their motion cannot be one of constraint.

<sup>164</sup> *De Caelo* 284 A 18-B 5; cf. *De Animal. Motu* 699 A 27-B 11 (page 169 *supra*).

<sup>165</sup> Plato, *Timaeus* 36 D-E.

<sup>166</sup> In *Metaphysics* 1050 B 20-28 the same argument is stated without mythological language. That which moves eternally is not, so far as the fact of its motion is concerned, potential. Consequently the heavens are continually active and there is no effort involved in their motion, because that motion does not imply the potentiality of its opposite. Here, too (1050 B 23-24) Aristotle remarks that this analysis shows it to be impossible for the motion of the heavens to cease, an eventuality "feared by the physical philosophers." This probably refers chiefly to Empedocles, as Alexander says; but, in so far as the destruction of this universe as such would involve a cessation of the celestial revolution, Aristotle evidently means to include all those who, like the Atomists, believed the world as we know it will be destroyed (cf. Hippolytus, I, 13, 3-4; Aëtius, II, 4, 6 [*Doxographi Graeci*, p. 331, 12]).

<sup>167</sup> Cf. *Physics* 212 B 7-22 (cf. page 145 *supra*). If the fifth essence has no natural place, it cannot have either natural rest or motion; if it has a natural place it must be at rest when in it. If it has no natural rest, it can have no natural motion and, consequently, no motion of constraint (see page 176, note 136 *supra*).



From the fact that circular motion is a simple motion the necessity of a simple body is deduced, a body of which this is the natural motion.<sup>168</sup> This can be none of the four primary bodies of our environment, for their natural motions are known to be rectilinear. The circular motion of the heavens, alone of all motions continuous and eternal, must be a natural motion; and, therefore, the heavens must consist of a fifth simple body. The motion of the sphere is enough to show that it cannot be fire as had sometimes been thought, for in that case its circular motion would be as unnatural to it as is downward rectilinear motion.<sup>169</sup> The stars themselves are composed of this same stuff.<sup>170</sup> For this conclusion Aristotle adduces the evidence of those who believed the stars to be fiery, for they, he says, held this theory as a necessary consequence of their belief that the heavenly sphere was fire, since it is reasonable to suppose that everything consists of the material which forms its environment. That all his predecessors believed the stars to have *some* fire in them seems certain; but it is not true that they all held the heavenly circuit to be fiery, and, consequently, the reasoning here attributed to them is impossible. Nor did they all believe that the stuff of the stars was fire.<sup>171</sup>

<sup>168</sup> *De Caelo* 268 B 26-269 B 6.

<sup>169</sup> *De Caelo* 269 B 6-13.

<sup>170</sup> *De Caelo* 289 A 13-19.

<sup>171</sup> Aristotle says that everyone declared the environment of the stars to be fire (*De Caelo* 291 A 20) and particularly that Anaxagoras did so, using "ether" as the name for "fire" (*De Caelo* 270 B 24-25). The opinions of the chief Presocratics in the matter were as follows: Anaximander said the stars were fire enclosed, save for a vent, by rings of air (Hippolytus, *Refut.*, I, 6, 4; Aëtius, II, 13, 7); for Anaximenes they are fiery, but they float on the air, and there are also earthy bodies in the heavens ([Plutarch], *Stromat.*, 3; Hippolytus, *Refut.*, I, 7; Aëtius, II, 13, 10; cf. *Doxographi Graeci*, p. 136); Heraclitus said they were receptacles in which fire collected (Diogenes Laertius, IX, 9; Aëtius, II, 28, 6); Empedocles thought them to be fire forced upward by air in the first segregation, but the fixed stars were implanted in frozen air (Aëtius, II, 13, 2; II, 13, 11); Anaxagoras considered them to be stones shining because of friction with the ether; there must have been some "seeds" of fire in all things and in the ether they may have predominated, but the stars were predominantly stone (Plutarch, *Lysander*, 12; Hippolytus, *Refut.*, I, 8, 6; Aëtius, II, 13, 3); for Archelaus, too, they were red-hot stones (Aëtius, II, 13, 6), for

Moreover, the heavenly bodies can have no free motion but must be embedded in the circles of the heaven in which they move as parts of a moving whole.<sup>172</sup> This Aristotle proves by showing that whether the heavenly sphere be thought to move free of the moving bodies or to be stationary while they move, the speed of the bodies themselves would have to vary directly with their proximity to the equator. But, since they are all of one substance, the law of natural motion would require for this variation in velocity a directly proportional variation in the size of the bodies and the impossible supposition that by sheer chance the bodies have been assigned latitudinal location exactly appropriate to their size and speed.<sup>173</sup> For all the stars, in whatever latitude, perform their revolutions in exactly the same time, a phenomenon to be saved only by assuming them to be embedded in the moving sphere. This truth established, the possibility of an harmony of sounds caused by the motion

Diogenes fiery pumice (Aëtius, II, 13, 5), and for the Atomists earthy congeries enflamed by the speed of their motion (Diogenes Laertius, IX, 32; Aëtius, I, 4, 3; II, 13, 4). Even if ὥσπερ πάντες φασιν (291 A 20) be thought to mean that all held the heavens to be *either* fire *or* air, the reasoning Aristotle constructs is false. Some said the stars were fire but the heavens were not, while Anaxagoras did not make the material of the stars that of their environment.

<sup>172</sup> *De Caelo* 289 B 7-290 A 7. The refutation is not represented as one of any special doctrine, although Aristotle evidently has in mind chiefly Plato (N. B. the criticism of rotation of the heavenly bodies which follows immediately, *De Caelo* 290 A 7 ff., and cf. *Timaeus* 40 A) and his followers and the Pythagoreans (to judge from the close connection between this discussion and that of the "harmony"). In *De Caelo* 291 A 18-22 the implication is that everyone thought the heavenly bodies had free motion, which certainly is not true if the "fixed stars" be included; but the phrase may be meant of the planets only, the stars being thought of as moving in a single mass (cf. 290 B 18-21). On the question as to whether the sphere of the fixed stars had motion in the Pythagorean system cf. Heath, *Aristarchus of Samos*, pp. 101 ff.

<sup>173</sup> That the doctrine of natural motion is, as I have here represented it to be, at the basis of Aristotle's criticism is clear from 289 B 33-290 A 5 (cf. Simplicius, *De Caelo*, 449, 11-29); in this passage he goes so far as to declare that the reason why the larger circle has greater velocity than the smaller circle on the same sphere is the same as the law that the larger the body the greater its velocity in its proper motion.

of the heavenly bodies at once disappears.<sup>174</sup> Some,<sup>175</sup> Aristotle says, thought that bodies of such size, moving with such speed, must produce sound of commensurate volume; they then supposed that the velocities, which they derived from the various distances of the bodies, stood in the ratio of musical intervals and said that the combined sound was an octave. We are not aware of it, they explained, because it has been constantly in our ears since birth and the distinction of sound depends upon its opposite silence.<sup>176</sup> If the stars and planets move, however, as fixed parts of a moving system they cannot possibly emit any sound, as the Pythagoreans claim, any more than does the mast which moves with the ship.<sup>177</sup>

The extent to which Aristotle can forget the implications of his dynamics from which the necessity for a primary immobile mover was proved appears in his discussion of the absolute directions in the universe. The Pythagoreans had distinguished absolute right and left and had affirmed that we live "to the right" (and so in the upper hemisphere), the southern hemisphere being "to the left" (that is beneath).<sup>178</sup> The six direc-

<sup>174</sup> *De Caelo* 290 B 12-291 A 26.

<sup>175</sup> Although he designates specifically the Pythagoreans (291 A 8), he probably is thinking of Plato as well (cf. 291 A 22 ff. οὐτ' ἂν ἐμψυχον . . . φέροιτο φορὰν and cf. *Republic* 617 A-B).

<sup>176</sup> Concerning the relation of this "harmony" to Pythagorean astronomical theory see Heath, *op. cit.*, pp. 107-115, Zeller-Nestle, *op. cit.*, I, 537-542.

<sup>177</sup> Aristotle adds the objection that, even if our accustomed ear perceives no sound, the force of the sound emitted would make itself felt since "the sound of thunder splits stones" (cf. *Meteorology* 371 A 17-29). The use of a ship for the example in *De Caelo* 291 A 10-16 (N. B. τηλικαύτης νεώς) may have been suggested by the traditional metaphor of the world-ship (cf. Plato, *Politicus* 272 E ff.) which was apparently part of the Pythagorean mythological vocabulary (cf. ὀλκάς, Philolaus, *fragment* 12 and Diels, *Vorsokratiker*<sup>4</sup>: Nachträge zum ersten Band, p. XXXVIII [B 12]; Aëtius, II, 4, 15 where the central fire is called the "keel" of the universe).

<sup>178</sup> *De Caelo* 284 B 6-285 B 33. In the Pythagorean list of opposites (*Metaphysics* 986 A 23-26) "right" and "left" are the only directions given. Aristotle says that the other four were neglected by the Pythagoreans (*De Caelo* 285 A 10-13) but later (285 B 26-27) remarks that they called our hemisphere "up" and its opposite "down." According to Simplicius (*De Caelo*, 386, 20-23), Aristotle in his book on the Pythagoreans (*fragment* 200) said that they ranged "up" and "forward" with "right," "down" and "backward"

tions, according to Aristotle, belong in an absolute sense only to living beings, up and down are defined by vegetative activity and so are found in all, front and back depend upon sensation, right and left upon local motion self-initiated. All six are to be found only in perfect animals.<sup>179</sup> The universe, being an animate body with its principle of motion within itself, must have all six; the Pythagoreans are particularly perverse in assigning to it only those two which are never present in the absence of the other four and in neglecting "up" and "down," the most elementary directions. Further, since "up" is the source of motion, "right" the point of initiation, "front" the direction of its progression, Aristotle insists that, since the stars rise in the East and must move toward the front, the South pole must be the upper pole and we must be in the lower hemisphere and to the left,<sup>180</sup> just contrary to the Pythagorean belief. This correction, however, is only valid for the sphere of the whole universe; he admits that in respect of the planetary motion we are in the upper hemisphere and to the right.

Apart from the fundamental triviality of this discussion and Aristotle's failure to make the only appropriate criticism possible, namely that the Pythagoreans were led astray by attaching literal meaning to what was merely a metaphor,<sup>181</sup> it is

with "left" (cf. the conflicting report and Alexander's correction: Simplicius, *De Caelo*, 392, 16-32; Aristotle, *fragment* 205), and this seems to be his reason for saying that they distinguished "upper" and "lower" hemispheres.

<sup>179</sup> Cf. the account in *De Incessu Animal*. 705 A 26-706 B 16.

<sup>180</sup> πρὸς τοῖς ἀριστεροῖς is added, according to Simplicius (*De Caelo* 392, 21-24), only in opposition to the Pythagoreans, the meaning being that, (if they say we are in the right-hand hemisphere and therefore in the upper one) since we are in the lower one, it is more correct to call it—following their system of identification—the left-hand hemisphere. The phrase is vague and may mean no more than this; but it is possible that Aristotle may mean that if we face our pole (North) we are to the left of the initiation of motion, while in the Southern hemisphere a man facing his pole (South) is to the right of the point from which the celestial motion begins.

<sup>181</sup> Cf. Simplicius, *De Caelo*, 386, 9-23. Aristotle probably intended the discussion to impress his audience as a veiled polemic against Plato's criticism of absolute directions (*Timaeus* 62 D ff.). The passage immediately preceding (*De Caelo* 284 A 27-B 5) attacks Plato's notion of the World-Soul as the cause of cosmic motion.



noticeable that the unmoved mover as an external cause has been forgotten for the moment and that the concept of the universe as an animate being is highly ambiguous in Aristotle's system.<sup>182</sup> The eternity of motion is not consistent, either, with a point of initiation; and Aristotle's explanation, that there must be a point from which motion could have started if it *had* ever started, hardly seems cogent.<sup>183</sup>

The Presocratic explanations of motion in the cosmic processes, particularly those of Empedocles and the Atomists, are subjected also to the test of the theory of natural motion and found inadequate because they fail to take account of it. If Empedocles makes "Love" and "Strife" the causes of motion, Aristotle believes that one must be the cause of natural motion and the other that of motion contrary to nature; but, though one might expect "Love" to be the cause of the former, the natural motion of the elements results in a separation of them one from another (as each moves to its proper place), so that it appears that "Love," which mixes all the elements together, is rather the cause of motion contrary to nature and "Strife" the cause of natural motion.<sup>184</sup> The conclusion implied seems to be that Empedocles misnamed his forces. But Aristotle proceeds to develop the absurdity of this theory of motion by pointing out that, if all motion is caused by these two forces, physical bodies have no inherent motion at all and so no natural rest, since for Aristotle natural rest is the result of the natural motion of a body to its proper place.<sup>185</sup> This is impossible, for it implies that no body can move or be at rest naturally, and that would remove the possibility of all rest and motion.<sup>186</sup> Yet the words of Empedocles himself inti-

<sup>182</sup> Note the trouble the commentators felt at this point; Simplicius, 387, 5-24.

<sup>183</sup> *De Caelo* 285 B 5-8. The question of the direction of motion of the celestial sphere involves a circular argument, for, while here he determines "right" and "front" as the point from which motion begins and the direction in which it proceeds, in *De Caelo* 287 B 22-288 A 12 he explains that the sphere moves in the direction it does because of circular motions the best is that from right forward to right again.

<sup>184</sup> *De Generatione* 333 B 26-33.

<sup>185</sup> *De Generatione* 333 B 33-35.

<sup>186</sup> Unnatural rest and motion imply natural motion and rest as prior, cf. *De Caelo* 276 A 10-15; *Physics* 215 A 1-6, 230 B 10-21.

mate that bodies *have* motion of their own, for, although they were separated by "Strife," he speaks of fire as "naturally rising" and of air as moving aloft, as it were by chance, and again as sinking down into earth.<sup>187</sup> Finally, Aristotle asks what is the prime cause of motion in this system,<sup>188</sup> since "Love" and "Strife" are obviously causes of specifically different movements but still Empedocles says that the state of the world now in the period of "Strife" is the same as it was formerly in the period of "Love." Here Aristotle's objection depends upon the supposition that in each of the two periods mentioned only one of the motor forces is at work; if this were so, then there would be need of explaining what cause is responsible for the similarity of result in the two periods, since the specific actions of "Love" and "Strife" are contraries. It is perfectly clear, however, that the organic world exists only when "Love" and "Strife" are both active in the world of elements, one gradually gaining the upper hand over the other.<sup>189</sup> That Aristotle should have failed to understand this fundamental mechanism in Empedocles' system seems incredible; yet it is necessarily so<sup>190</sup> and, once understood, must awaken extreme vigilance in all who use his interpretations as evidence for earlier philosophies.<sup>191</sup> For Aristotle's conten-

<sup>187</sup> *De Generatione* 333 B 35-334 A 5. To prove that air moves sometimes by chance, Aristotle quotes Empedocles, *fragment* 53, which he quotes again in *Physics* 196 A 20-23 to show that Empedocles recognized chance as a cause of some sort. The line saying that air sinks down (*fragment* 54) occurs only in Aristotle's quotation here.

<sup>188</sup> *De Generatione* 334 A 5-9.

<sup>189</sup> Empedocles, *fragments* 35; 17; 71. Aristotle himself noticed the importance of the "battle of 'Love' and 'Strife'"; but he seems to have confined it to the moment when the *Sphere* was invaded (and, possibly, the moment when "Love" reentered what he thought to be the period of rest under the dominance of "Strife," cf. page 175, note 130 *supra*); cf. *De Generatione* 315 A 15-19.

<sup>190</sup> Simplicius charges Alexander with the same blunder; the latter was influenced evidently by the obvious meaning of the Aristotelian passages (cf. Simplicius, *De Caelo* 528, 29 ff.). See page 192, note 199; page 195, note 210; page 231, note 62 *infra*.

<sup>191</sup> This very passage has been widely used to support the theory that Empedocles held to a cycle of four distinct periods. Cf. Millerd, *op. cit.*, p. 45.



tion that Empedocles himself at times speaks of bodies moving by agencies other than the two specified forces the remaining fragments reveal much verbal support; but it must be said for Empedocles that he seems not to have claimed that all motion was caused by "Love" and "Strife" *directly*. Evidently he supposed that the bodies set in motion by these primary forces would in turn affect other bodies against which they struck or upon which they pressed;<sup>192</sup> such secondary causes of motion are not inconsistent with the notion that the ultimate motors are "Love" and "Strife," but the complicated composite movements resulting from them would seem to a poet best described as the results of chance. But the extent to which chance is personified almost justifies Aristotle in his belief that many processes were directly ascribed to it by Empedocles.<sup>193</sup>

<sup>192</sup> Cf. the mechanism by which rotation of the heavens is begun ([Plutarch], *Stromat.*, 10) and the explanation of breathing (*fragment* 100). Evidently the whirling eddy (*fragment* 35, 3-4) is the direct cause of many particular movements (cf. Aëtius, II, 6, 3).

<sup>193</sup> Cf. Empedocles, *fragment* 103; Aristotle quotes *fragment* 53, but *fragment* 59 shows how at times the "haphazard" movements and combinations are admittedly due in the end to the struggle of "Love" and "Strife." Millerd believes that for Empedocles matter had motion of its own and that "Love" and "Strife" were not universal motor causes; Burnet (*E. G. P.*,<sup>3</sup> p. 233) and others have maintained that the attraction of like for like plays a separate and important rôle in the system. But there is no mention of this tendency as a separate principle and the statements in which it seems to be implied (e. g. *fragment* 62, 6) are as naturally explained by the influence of "Love" and "Strife" (cf. Millerd, *op. cit.*, pp. 34-38 and particularly Zeller-Nestle, *op. cit.*, I, 995, n. 1). It must be remembered, however, that "Love" and "Strife" do not work on the four roots as spatially external motors; there is no void, the whole cosmos is filled with the four roots, and "Love" and "Strife" enter *into* them in turn, so that attraction and repulsion in bodies seem to spring from the bodies themselves. Even so these forces are within mortal creatures, unseen (cf. *fragment* 17, 22 ff.; 35, 9-13). But the "hylozoism" is only a false appearance. Again, since there is no void, if a portion of one root is permeated by "Strife" and so repelled from all the other roots, it can be moved in no direction other than that of some other portion of the same root as itself; in this way the process may seem to be attraction of like to like but is really due to the presence of the repellent force. Aristotle's repeated objection (*Metaphysics* 985 A 23-29, 1000 A 26-B 12) that "Love" is as much a cause of segregation as of combination while "Strife" combines in the act of segregating or that "Love" and "Strife" are equally causes of destruction and genera-

The manner in which Aristotle uses the doctrine of natural motion to prove that the infinite void of the Atomists and their qualitatively undifferentiated elements are inconsistent with phenomena has already been considered;<sup>194</sup> the same consideration makes it impossible for Atomism to account for motion.<sup>195</sup> The atoms, it is said, are always in motion in the infinite void; if they move one another by force, this motion is one of constraint, unnatural, and as such presupposes a natural motion to which it is contrary.<sup>196</sup> At any rate, to avoid an

tion, a judgment approved by Burnet, is essentially pointless, for it rests on misinterpretation of the fundamental concepts of Empedocles' system. The false assumptions of the criticism are 1) that there is real generation, in Aristotle's sense, of the elements from an unqualified material substrate and real "destruction" of them to form this primary matter, 2) that the two forces work independently so that "Strife" alone ought to be the cause of all individual existence, 3) that the segregation of the roots from one another, being a concomitant aggregation of each, should be the result of a combining force. This last supposition, one which has given rise to many of the modern theories about the system, is due in large part to Aristotle's tendency to treat Empedocles as an unconscious Atomist and so to think of the fragments of a disintegrated root as essentially individual objects. But, since to Empedocles all of each root was a single continuous mass, there was no reason for asking why the fragments of any one should come together whenever possible; the forces of combination and disintegration are needed only to explain the relationships of the four bodies to one another. It would have appeared absurd to Empedocles to talk of an attraction of one real individual to itself or repulsion from itself; and, since the only really individual objects are the four roots, each single and unique, it is mere jugglery to insist that the repulsion of air from fire is the same as attraction of air to air.

<sup>194</sup> Pages 7-8, 33 *supra*.

<sup>195</sup> *De Caelo* 300 B 8-16. The Atomists conceived motion to be one of the essential characteristics of the atoms and so, as a first principle, to need no further explanation (cf. page 179, note 146 *supra*); secondary movements, however, resulted from the collision of the atoms, their shape and size evidently contributing to the direction and character of the resulting motion (cf. Aristotle, *fragment* 208, *apud* Simplicius, *De Caelo*, 295, 9-13 and Bailey, *The Greek Atomists and Epicurus*, pp. 82-87, 129-137).

<sup>196</sup> The argument to force the Atomists to admit a natural motion is put differently in *De Caelo* 276 A 8-15. Every motion must be either natural or contrary to nature, and this distinction is defined by proper place. Hence movement implies spatial distinction, and that place in which a given body rests or moves contrary to its natural motion or rest must be the place of the natural rest and motion of some other body. In *De Caelo* 277 A 33-B 9 Aristotle tries



infinite regress, Aristotle contends, the original movement by which the series of constrained motions was initiated must have been natural. Thus he feels that he has forced on the Atomists the necessity of natural motion, at least as an initial cause of subsequent movement; he then proceeds to show that this necessity rules out the possibility of a precosmical motion,<sup>197</sup> beginning his demonstration with a rhetorical question.<sup>198</sup> If all things were originally involved in disorderly movement, was it possible for them to form now and again such combinations as those of which natural bodies consist, as Empedocles says that in "the period of Love" many heads sprang up without necks?<sup>199</sup> The dilemma which Aristotle

to prove that the upward motion of fire and the downward motion of earth are due to inherent natural tendency and not to constraint by pointing out that, whereas a body moving under constraint has a velocity inversely proportionate to its size and steadily decreases its velocity in its course of motion, experience shows that the larger the body of fire the faster it moves upward and the farther the motion proceeds the greater the velocity becomes. The same holds true of the motion of earth downward; and earth cannot be moved upward save by constraint or fire downward, although any body will move without constraint to that place from which it moved under constraint. This is given as a refutation of those who suppose that natural bodies move by reason of the pressure of surrounding bodies which thus "squeeze" them out of place. The position of the argument in a refutation of the theory of manifold worlds and Aristotle's reference to the mechanism elsewhere in connection with Atomistic doctrines (*De Caelo* 310 A 7-11, *Parva Naturalia* 471 B 30-472 A 16, *De Anima* 404 A 10-13; cf. Philoponus, *De Generatione*, 165, 33 ff.) show that Aristotle is thinking chiefly of the Atomists, although he may have meant the refutation to have a wider application. The mechanism was used later by Strato and Epicurus (*Epistle* II, 109) and perhaps widely before Aristotle's time (cf. Empedocles, *fragment* 38 with Aëtius, II, 6, 3).

<sup>197</sup> In *De Caelo* 300 B 16-25 he attacks the description of a disorderly motion antecedent to the creation of the world as described in Plato's *Timaeus* 30 A; and the subsequent refutation of the Atomists is intended to apply to Plato also.

<sup>198</sup> *De Caelo* 300 B 25-31.

<sup>199</sup> Cf. Empedocles, *fragment* 57. Alexander thought the quotation was merely for the purpose of illustrating what kind of mixtures were meant; but Simplicius is probably right in thinking that it is a covert criticism of Empedocles for supposing that such "haphazard" and partial combinations could arise under the influence of "Love" which is supposed to form a perfect mixture of all things. Aristotle insists that Empedocles could not consistently create an organic universe in the period of "Love" (301 A 15-20); that interpreta-

does not develop from this question (probably because it seems obvious to him) is that neither an affirmative nor a negative answer will allow the precosmical motion to be completely disorderly. If such combinations cannot occur, there are definite motions excluded, and the whole is not entirely without order; if they can occur, then natural bodies will be formed and there will be natural motions in their formation.<sup>200</sup> The same problem is put more abstractly in the sequel.<sup>201</sup> The Atomists say that an infinite number of bodies is moving in the infinite; if the motor cause is single, however, the motion of all is identical and there is no irregularity.<sup>202</sup> If the moving causes are infinite, there would be an infinite number of motions, too, which for Aristotle is contrary to the observed fact that the simple motions are limited;<sup>203</sup> and, if the movents are finite, there will be some organized system. In any case, then, complete disorder is impossible; but to speak of a universal movement of disorder is simply a misuse of language, for "disorderly" means only "contrary to nature" and the nature of sensible bodies is the set of characteristics presented by most of them most of the time.<sup>204</sup> Consequently, the Atomists, in making disorderly movement natural, can no longer call it "disorder;" that term they must apply to the movement of the present cosmos.

In this way it appears that any precosmical motion is absurd,

tion and this are equally due to the false supposition that "Strife" has no influence during this period (cf. pages 189, note 189; 189, note 190; 190, note 193 *supra*; Simplicius, *De Caelo*, 586, 25-587, 26).

<sup>200</sup> Not only will the bodies, once formed, have natural motion from which a cosmos will result, as Simplicius puts it; but, since natural bodies can be formed only in definite ways, natural and ordered motion will precede their formation. The whole Aristotelian system of natural motion, simple bodies, and generation from opposites is assumed in this argument.

<sup>201</sup> *De Caelo* 300 B 31-301 A 11.

<sup>202</sup> In *De Caelo* 275 B 29-276 A 4 from the qualitative identity of the atoms is deduced the necessity of identical motion for all (cf. page 7 *supra*).

<sup>203</sup> See page 7 *supra*. Alexander (*apud* Simplicius, *De Caelo*, 588, 20-22) suggests that the impossibility of two infinities would result. This paradox is used by Aristotle in *De Caelo* 275 B 18-25.

<sup>204</sup> Cf. *Physics* 198 B 34-199 A 3; *De Generatione* 333 B 4-7; *De Part. Animal.* 663 B 27-29; *Metaphysics* 1026 B 27-1027 A 28.

for, viewed as different from the cosmic motion, it implies that the contrary to nature is prior to the natural or that the cosmos itself and its motion are contrary to nature. Aristotle believes that he can find a recognition of this difficulty even among the Presocratics.<sup>205</sup> Anaxagoras began his creation of the cosmos from an antecedent state of rest.<sup>206</sup> Aristotle assumes that he did so because he saw that a pre-cosmical movement would involve him in the difficulties which have just been shown to beset the Atomists. Since these difficulties depend for their validity upon the Aristotelian concepts of "natural" and "unnatural" motion and of contrariety as the terms of all movement and change, it is hardly necessary to prove that Anaxagoras could not have thought of the motive here assigned to him. But the fact of precosmical rest, at least, is historically correct for him; Aristotle seeks to extend it now to "others" and so to attribute to other cosmologists as well a recognition of the self-contradictions which he has shown to be involved in motion antecedent to the cosmos. "The others" too, he says and by that phrase implies that all the cosmologists are meant, before they introduce the segregating movement which articulates the cosmos, seek to bring their material together into a mixture. In short, he is trying to attribute to the Ionians a precosmical material which is at rest. His tendency to find in the principles of all the material monists his own undifferentiated matter aids him in part of this interpretation;<sup>207</sup> but he could find no evidence that any such principle was considered to be static before this universe began<sup>208</sup> and for an example is forced back upon Empedocles, who, he says, neglected the period of "Love" because he saw that the universe which consists of discrete ele-

<sup>205</sup> *De Caelo* 301 A 11-20.

<sup>206</sup> For Aristotle's castigation of Anaxagoras' theory of an original state of rest see page 32 *supra*.

<sup>207</sup> See pages 53 ff. *supra*.

<sup>208</sup> The Ionian assumption that matter involved motion elsewhere is recognized by Aristotle himself, when he objects that those philosophers simply assumed matter in motion, and is even developed by him into an explicit theory of an ἀρχὴ κινουμένη (cf. *Physics* 184 B 15-18 and page 173, note 128 *supra*).

ments could not be represented as coming to be from elements already discrete and in motion. Generation is from contrary to contrary, and Empedocles is assumed to have reasoned from this axiom that he could not construct the present world by concretion but must represent it as an articulation of a primal unified mixture. Now, it is true that the phrase παραλείπει τὴν ἐπὶ τῆς φιλότητος can mean merely that Empedocles omits any *detailed* account of the cosmology during the period in which "Love" is on the increase and so can be reconciled with the fact that a large fragment still extant deals with this period;<sup>209</sup> but it is not possible that this can be Aristotle's meaning, for he cites Empedocles expressly to prove that no cosmos can be developed by a process which starts from the elements in segregation and ends with them in complete mixture, and he means the reader to understand that Empedocles shared this belief. That Empedocles constructed a cosmos both during the increase of "Love" and that of "Strife" Aristotle knew, but he treated that part of the theory as an impossible vagary; and he did so simply because he failed to see that in both periods both forces are at work.<sup>210</sup> Wherever in the cycle the account of Empedocles may have begun, it is obvious that no period was meant to be primary. Aristotle here talks as if Empedocles

<sup>209</sup> So Millerd, *op. cit.*, p. 52.

<sup>210</sup> In *De Generatione* 334 A 5-7 Aristotle recognizes that our world exists under the influence of "Strife" and is the same as that which exists during the increase of "Love"; but he tries to show that such a supposition would require the influence of another force, the same in both periods, because he does not see that in both worlds both "Love" and "Strife" are at work (cf. page 192, note 199 *supra*). So here he assumes that during the "period of Love" only the force of combination would be at work (cf. 301 A 18: σύγκρισιν δὲ ποιῶν διὰ τὴν φιλότητα). Even in the fragments extant there are descriptions of the formation of a cosmos during the increase of "Love" (fragments 35, 57 which Aristotle himself assigns to the period of "Love" [*De Caelo* 300 B 28-31, cf. page 192, note 199 *supra*], 61); it is small wonder, then, that Simplicius thought the only way in which the consistency of Aristotle could be saved was by referring ἐπὶ τῆς φιλότητος to the *Sphere* itself (Simplicius, *De Caelo*, 590, 24 ff.) and supposing Aristotle to mean that Empedocles omitted to give any *arrangement of the elements in the mixture of the Sphere*, for Simplicius himself knew that there was a cosmos formed during the increase of "Love" (Simplicius, *De Caelo*, 587, 12 ff.).



really began with the *Sphere*; but that is no more evidence for the order of the poem than is his insistence that the *Sphere* was undifferentiated matter evidence for the metaphysical doctrine of Empedocles.<sup>211</sup>

The doctrine of natural motion determines the entire astronomy of Aristotle. By means of it he proved that no infinity, corporeal or spatial, could exist;<sup>212</sup> but it also serves to demonstrate the uniqueness of the cosmos,<sup>213</sup> for the essential characteristics of the simple bodies and the necessary identity of these characteristics wheresoever these bodies may be situated requires absolute direction, that is an unique center and an

<sup>211</sup> In *De Generatione* 333 B 20-22 Aristotle insists that the elements were prior to the *Sphere* because he wants to show that "Love" is really a segregating force. In *De Generatione* 315 A 19-21, however, where he seeks to show that Empedocles admitted the generation of the elements from a common material and so should have allowed them to arise from one another, he argues that the *Sphere* was an homogeneous material and complains that Empedocles does not allow one to decide whether the *Sphere* or the elements were prior, inasmuch as the elements arise from "alteration" of the *Sphere* and the *Sphere* from combination of the elements. In *Metaphysics* 1091 B 4-12, nevertheless, desiring to find authority against Speusippus concerning the priority of the final cause, Aristotle argues that "Love," which he identifies with the Good, was the "generating" cause, which implies that the organic world is due to the force of "Love" alone (cf. page 223, note 26 *infra*).

<sup>212</sup> See pages 26, 30, 33, 35 *supra*; and *De Caelo* 275 B 12-29 the "dialectical" argument: what is infinite cannot move in a circle, since a circle moves about a center, or in a straight line, for there would have to be two spatial infinities, one in the direction of the natural motion of the infinite, another in the direction of its unnatural motion. The moving force would have to be infinite which would result in two infinities.

<sup>213</sup> *De Caelo* 276 A 18-277 B 26. The argument is a refutation not alone of the Atomists but also of all who suppose that several worlds may exist simultaneously whether these be infinite or finite in number, a notion which Aristotle attributes to some of the material monists; cf. *De Caelo* 303 B 10-13, the report on Diogenes in [Plutarch], *Stromat.* 12, and page 173, note 128 *supra*. Burnet (*E. G. P.*,<sup>8</sup> p. 109) thinks the Pythagoreans also, at least in early times, believed in a plurality of worlds, but Aristotle includes them among the partisans of a single universe (Aristotle, *fragment* 201). Although *Physics* 203 B 25-26 might appear to imply that the Pythagoreans held to a plurality of worlds (for they believed that an infinity existed outside our heaven), a comparison with *Physics* 250 B 18-20 makes it probable that there Aristotle had only the Atomists in mind.

unique extremity. If the term "world" is not merely homonymous, Aristotle argues, it must be supposed that the other worlds, which are assumed to exist, have the same essential characters as ours. Now earth moves naturally to the center of our world and fire away from the center; if in another world a similar law holds, there would result the absurdity of assuming several natural motions for the same simple body. Since the identity of a simple body is defined by the identity of its natural motion, the earth in all worlds must move in the same direction, which proves that there can be only one cosmos. Again, movement implies two extremities and an interval. Since the center is the natural place of body that is absolutely heavy, the other extreme, the periphery, must be the natural place of what is absolutely light, and all bodies with intermediate weight and lightness must have their natural places in the interval. Consequently there can be no matter and so no world beyond the sphere of this world.<sup>214</sup>

It is apparent that this argument requires Aristotle to insist that the earth is at the center of the cosmos and that this is the absolute center. But not all the Presocratics accepted this arrangement. Most of his predecessors, he says,<sup>215</sup> who made the universe finite supposed the earth to be situated at the center;<sup>216</sup> but the so-called Pythagoreans in Italy said that there is fire at the center around which the earth circles as one of the stars and causes night and day.<sup>217</sup> They also invented a

<sup>214</sup> In *Metaphysics* 1074 A 31-38 the uniqueness of the cosmos is proved by showing that the unmoved mover as complete reality is immaterial and therefore one in form and in number; from this it follows that what is moved by this motor eternally and continuously is one.

<sup>215</sup> *De Caelo* 293 A 17-B 30.

<sup>216</sup> Those who posited multiple worlds in infinite extension, as did the Atomists, Anaximander, and Anaximenes, could hardly have placed the earth in the center of infinity; but they did put it in the center of its own particular cosmos. Aristotle here confines himself, however, to those who made the whole finite.

<sup>217</sup> Cf. Aristotle, *fragment* 204. The theory is attributed to Philolaus by Aëtius, II, 7, 7 (*Doxographi Graeci*, pp. 336-337); III, 13, 2 (*Doxographi Graeci*, p. 378, 6-9). Aristotle remarks (*De Caelo* 293 A 27-293 B 1) that there are others who on *a priori* grounds could agree with this theory because they believe that fire is more noble than earth and so merits the noblest position

body which they call the counter-earth which likewise circles about the central fire over against the earth. Aristotle asserts that these Pythagoreans thought the center, as the most important part of the whole, should be a fastness and so called the fire at the center "the fastness of Zeus." Against this he argues that they confuse the geometrical center with center of the nature of an object, for in the universe just as in a living being the center of the body and that of the creature as living are not the same; and he goes so far as to contend that what the Pythagoreans honor as the "principle" is rather the end, inasmuch as the spatial center is limited rather than itself the limit.<sup>218</sup> So he meets argument from metaphor with still more strained metaphor; but he criticizes the hypothesis of a counter-earth as an hypothesis which tries to force the phenomena to fit a preconceived set of opinions.<sup>219</sup> When, however, he goes on to say that some<sup>220</sup> thought there were "many such bodies"

which in a sphere is the limit, that is the center and the periphery. This is usually taken to refer to some contemporaries probably in the Academy (cf. Heath, *op. cit.*, pp. 185-7). There are two passages of Plutarch (*Quaest. Plat.* 1006 C and *Numa*, 11), one of which cites Theophrastus as its source, which say that Plato in his old age repented of putting earth in the center. Burnet, *Thales to Plato*, pp. 347-8 maintains that this is "unimpeachable testimony" and uses it to support his interpretation of *Timaeus* 40 B; but it could have nothing to do with the *Timaetus* passage for there the earth, whether moving or stationary, is at the center. Later (*E. G. P.*<sup>8</sup>, pp. 304-5) Burnet uses the same evidence to contend that Plato abandoned the geocentric hypothesis but claims that what he substituted for it is not known. Yet the passage from Plutarch's *Numa* implies that fire must be put at the center. The wording of this passage is so much like the present passage of Aristotle that it justifies the suspicion that Theophrastus reconstructed his report from this very passage probably under the influence of Heraclides Ponticus. On the whole question see the final chapter of this book (pp. 393-397).

<sup>218</sup> But in *Physics* 265 B 2-4 Aristotle says that the center of a sphere is ἀρχὴ καὶ μέσον τοῦ μεγέθους καὶ τέλος.

<sup>219</sup> So in *Metaphysics* 986 A 6-12 the Pythagoreans are said to have invented the counter-earth in order to bring the number of heavenly bodies up to the perfect decad.

<sup>220</sup> Presumably some Pythagoreans (so Alexander, *apud* Simplicius, *De Caelo*, 515, 25-26). Anaximenes (Hippolytus, *Refut.*, I, 7, 5) and Anaxagoras (Hippolytus, *Refut.*, I, 8, 6-7) assumed dark bodies in the heavens also; but the added explanation here that "their invisibility is due to interposition of the earth" shows that the reference is to the Pythagorean theory.

(as the counter-earth) and that, since each one of them as well as the earth obscures the moon, the reason why lunar eclipses are more frequent than solar eclipses was so explained, he shows that he is aware of the baseless captiousness of his former criticism.<sup>221</sup> There is an indication that opponents of this theory prior to Aristotle had objected that if the earth really revolved about the center there ought to be evidence of parallax, for he says that the Pythagoreans thought that it makes no difference in the phenomena if the earth is not situated at the center since, in any case, an observer on its surface is not at the center but is removed therefrom by the distance of its radius.<sup>222</sup>

The clear fact that any portion of earth has as its natural motion movement toward the center in a straight line shows that, if the earth as a whole moves either at the center or outside of it, this motion must be one of constraint and as such cannot be eternal.<sup>223</sup> This contradicts the proposition, however, that the order of the cosmos is unending. Furthermore, any motion of the earth about the center or at the center would necessitate apparent excursions and retrogressions of the fixed stars which in fact are not observed. This argument that motion of the earth would prevent the stars from rising and setting always in the same positions rests upon the assumption that the earth would have to have two motions at least; and this assumption is derived by analogy from the fact that all the bodies which have circular motion (except the fixed stars), that is all the planets, have beside their own motion the motion of the celestial sphere. Of course, this argument does not refute a theory which assumes a single motion of revolution about the center once in twenty-four hours; there is some evidence, however, that the Pythagoreans made the earth revolve in the circle of the ecliptic about the central

<sup>221</sup> Aëtius, II, 29, 4 says that Aristotle himself (in his work on the Pythagoreans probably) said that lunar eclipses were explained by interposition of the counter-earth.

<sup>222</sup> Cf. Heath, *op. cit.*, p. 100; E. Frank, *Plato und die sogenannten Pythagoreer*, p. 41 and note 71.

<sup>223</sup> *De Caelo* 296 A 24-B 26.



fire,<sup>224</sup> and Aristotle, assuming the impossibility of free motion, would suppose such a course possible only as a composition of the motion of the celestial sphere and a retrograde motion of the special sphere of the earth.<sup>225</sup> It is because he interprets the theory criticized only after recasting it into his own celestial mechanics that he can argue that such a motion of the earth must be analogous to that of the higher planets. But, even if this assumption can be explained in the case of terrestrial revolution, it is difficult to understand why motion *at* the center should necessarily be complex and consequently involve the difficulties he supposes.<sup>226</sup>

The motion of the whole earth is naturally toward the center, since that is the direction of any and every part of earth in natural motion; but that motion is essentially toward the center of the universe and only accidentally toward the center of the earth itself as is shown by the fact that the natural motion of fire is in the direction of the extremity which encloses the center. The fact that falling weights are borne downward not in parallel lines but in courses which form equal angles with the horizontal plane at the point of contact shows that the natural motion of earth is toward a single center; the experiment, which reveals that bodies thrown into the air, however high they be thrown, descend in a straight line to the same spot from which they were sent, proves that the earth does not move.

The shape of the earth, as well as its immobility, is determined by the natural motion of the elements. The opinion of philosophers had been divided; according to some the earth was a sphere, while to others it seemed flat, in shape like a

<sup>224</sup> Aëtius, III, 13, 2 (*Doxographi Graeci*, p. 378, 6-9).

<sup>225</sup> Naturally he would require more than these two motions to fix the sphere of the earth within the planetary spheres.

<sup>226</sup> It is clear that he means by "motion at the center" rotation on its own axis since he applies to both possibilities the phrase ἐγκύκλιον φοράν and it is further clear that he is referring to what he supposes to be the theory given in the *Timaeus* of Plato. Hence it can be said against Burnet, who uses the evidence of Aristotle with great assurance (*E. G. P.*<sup>3</sup>, pp. 302-4), that Aristotle did *not* believe that the theory there given was such as he (Burnet) represents it, an "up and down" motion on the axis of the universe.

tambourine.<sup>227</sup> Aristotle gives an argument used by some exponents of the flat earth to support their belief. They pointed out that the section of the rising or setting sun makes a straight line with the horizon; to this he answers that they fail to take into account the distance of the sun and the size of the earth's circumference. The argument that the earth must be flat because it is at rest, however, Aristotle considers at greater length, for the questions of its immobility and shape had been long connected and had been given many explanations. There were some who, baffled by the inconsistency of a stationary earth with the experience that all fragments of earth fall, in order to save themselves the trouble of investigating the cause answered that the earth stretched downward to infinity. Among these was Xenophanes.<sup>228</sup> The oldest theory known to Aristotle is that which tradition gave to Thales, that the earth lies upon water. Aristotle supposes that Thales derived this theory from the observation that such things as wood float on water

<sup>227</sup> *De Caelo* 293 B 33-296 A 21. Pythagoras is reported to have been the first to pronounce the earth a sphere. Parmenides also is said to have held this opinion (Diogenes Laertius, VIII, 48, cf. Heath, *op. cit.*, pp. 21, 48-9, 64). If the statement appeared in the second part of Parmenides' poem, it may not have represented his own opinion; since Aristotle often enough represents the descriptions in the "Way of Opinion" as Parmenides' own doctrine, it is probable that Theophrastus too took excerpts from it in the same sense.

<sup>228</sup> Cf. Xenophanes, *fragment* 28; Aëtius, III, 11, 2; III, 9, 4. Aristotle then (*De Caelo* 294 A 24-28) quotes three lines of Empedocles (*fragment* 39) against "many" who prate of boundless depths of earth and profuse air, saying that this was a censure of Xenophanes. In *Metaphysics* 986 B 21-24 Aristotle refers not to whether Xenophanes made the one "infinite or finite" but to the question of whether that unity was regarded by Xenophanes κατὰ τὸν λόγον or κατὰ τὴν ὕλην. Burnet is misleading when he says (*E. G. P.*<sup>3</sup>, pp. 124-125) that Theophrastus decided that Xenophanes thought the world spherical and finite. Hippolytus (*Refut.*, I, 14), whose evidence Burnet accepts, says that to Xenophanes *God* was one, finite, and spherical and immediately adds that he thought the earth infinite, surrounded neither by air nor by heaven. The fragments give no reason to suppose that he identified God and the world; and it is likely that the notion of a "spherical" god was inferred for him from the unity which he predicated of God (*fragments* 23-26; cf. *Metaphysics* 986 B 24). Aristotle would be encouraged to impute to Xenophanes the reasoning of Parmenides merely on the strength of Plato's half-fanciful remark (*Sophist* 242 D) that the Eleatic school began with Xenophanes "and even before" (cf. Ross on *Metaphysics* 986 B 21).



but not on air; but he points out that such a theory only postpones the real problem, for water cannot be suspended without support. This objection would not have seemed cogent to Thales if he thought, as he probably did,<sup>229</sup> that there was no end to the water under the earth; and Aristotle consequently adds further objections. Since air is lighter than water and water lighter than earth, how can the lighter body, water, be situated below the heavier, earth? Further, if the whole earth rests on water, why is it that a fragment sinks through water, especially since the larger the fragment is the faster it sinks? These questions confronted Anaximenes, Anaxagoras, and Democritus, also, even though for them it was not water that sustains the earth. Their answer was that the flat shape of the earth sustains it by enclosing the air beneath it as if under a lid;<sup>230</sup> and, calling attention to the fact that flat sur-

<sup>229</sup> The notion of Simplicius (*Phys.*, 23, 22 ff.) that Thales posited a *finite* element is due to a misconception of the meaning of *Physics* 184 B 15-21 and is directly refuted by Aristotle, *Physics* 203 A 16-18 (where Simplicius also contradicts his previous statement). This is not to imply that Thales explicitly designated water as infinitely extended.

<sup>230</sup> For Anaximenes cf. Hippolytus, *Refut.*, I, 7, 4; Aëtius, III, 10, 3 (the earth is table-shaped). Anaxagoras added to the shape and size of the earth as a cause for its suspension the fact that there is no void (Hippolytus, *Refut.*, I, 8, 3); Leucippus said the earth was shaped like a tambourine, but its position in the center of the whirl he seems to have attributed to the tendency of the larger complexes of atoms to gather in the center, so that it is the motion of the whirling atoms which keeps it there (Diogenes Laertius, IX, 30-32); Democritus held the earth to be the shape of a disc but added that it was concave (Aëtius, III, 10, 5; cf. Heath, *op. cit.*, p. 124), and he is credited with having attributed its immobility to equilibrium (Aëtius, III, 15, 7). In this latter opinion he is associated with Parmenides who probably repeated it in the "Way of Opinion" from Anaximander (Hippolytus, *Refut.*, I, 6, 3). But Democritus is more likely to have made the cause of the "equilibrium" the whirl, as Leucippus explained it, than simply the equidistance of the earth from all other bodies. Consequently Aristotle appears to have wrongly extended the explanation given by Democritus of the phenomenon of floating to an explanation of the earth's immobility. In fact, it is likely that all those who believed the cosmos to be a whirling eddy with earth at the center (Anaximander, Anaximenes, Anaxagoras, the Atomists) thought of the flat earth as rotating about its short axis which is the center of the eddy (cf. Burnet, *E. G. P.*<sup>3</sup>, p. 66, n. 3; p. 300, n. 1), so that strictly they did not think the earth immobile save in so far as it does not move away from the center of the whirl.

faces are hard to move against a wind because of the resistance, they said that the air gathering under the earth acts toward the earth just as it does toward the water in a clepsydra. To this theory Aristotle replies first that, even were the explanation correct, the cause of the earth's suspension in air would not be its shape but rather its size, since the quantity of air at rest under the earth and sustaining it depends upon the size of the earth itself which shuts off this air from escape. Consequently, if this theory is correct, the earth could as well be spherical as flat.<sup>231</sup> But the entire problem resolves itself into a recognition of the consequences of natural motion. Unless there is such a motion essential to bodies, there can be no motion at all nor any rest, since constrained motion and rest both imply natural motion. If the earth is held immobile by constraint it was brought to the center by constraint, which is in sum what all these philosophers mean who say it was formed in "the whirling eddy." This notion occurred to them when they observed the heavy particles in whirlpools and

<sup>231</sup> For Aristotle the shape of a body, while not the cause of its motion, is a contributory cause of the speed with which it moves through a medium. This he explains in *De Caelo* 313 A 21-B 21 after refuting the theory devised by Democritus to explain why flat bodies, though heavy, will float when lighter ones, if round or long, sink. He said that warm effluences from the water (presumably the spherical atoms or groups of atoms flying off from the surface) hold up flat bodies because they present a greater surface against which the effluences can strike, while narrow bodies are struck by fewer of these effluences and so sink. According to Aristotle, Democritus himself saw that, if this were true, the same phenomenon ought to occur even more obviously in air (evidently because there is more warmth in air than in water); but that such heavy bodies do not float in air he explained by saying that there this surging motion is scattered and so does not take place in a single direction. This Aristotle considers to be a lame answer; his own explanation is that continuous bodies vary in the ease with which they are divisible directly as the variation in their fluidity. Air, then, is more easily divisible than water, water than earth; and the smaller the quantity the more easily dispersed is any one of the bodies. Flat bodies, consequently, float better than those of other shapes because they enclose a quantity less readily dispersed; and bodies float in water, though not in air, because air is essentially more easily divided than water. The speed of motion through a medium, then, is determined by the relationship of the force in the body which has natural weight to the inherent power in the medium to maintain its continuity.



atmospheric eddies moving to the center; and for this reason all who generate the universe make the earth come together at the center.<sup>232</sup> But they then seek a reason for its continued rest at that point. Apart from those who give its flatness and size as this reason, there are some<sup>233</sup> who, like Empedocles, say that the swift revolution of the heavens overcomes the earth's tendency to move just as a cup swung swiftly in a circle prevents the water in it from falling.<sup>234</sup> In either case, Aristotle asks, if the whirl or the supporting air should for a moment not prevent the earth from moving, whither would it move? If it moved to the center under constraint and remains there under constraint, it must have some natural motion away from the center, and if there is no more reason why this should be "downward" than "upward," obviously it is not the air above the earth that prevents it from moving away from the center in that direction. Consequently, it cannot be the air under the earth that prevents it from moving downward from the center and so maintains it at rest. This argument really proves only that, if the earth is kept at the center because of the revolution of the whirl, it is not necessary to add that the air beneath it keeps it in place. Aristotle can believe that his refutation is cogent against the theory that the whirl keeps the earth in place only because he thinks it absurd that in the absence of the whirl the earth would be dispersed equally

<sup>232</sup> So the Ionians, Anaxagoras, Empedocles, and the Atomists. But, if the Pythagoreans who made the earth revolve about a central fire are the same as those who "constructed the universe" according to Aristotle's account (cf. *Metaphysics* 1091 A 13-22, page 39 *supra*), they are an exception to the universal statement here as is Plato also, for Aristotle constantly says that he "generated the universe."

<sup>233</sup> Probably the Atomists explained the continuance of the earth at the center by the continued motion of the eddy (cf. page 202, note 230), although Aristotle cannot be thinking of them here.

<sup>234</sup> The experiment here mentioned was obviously not intended to explain why the earth does not fall but why the outer water, air, and fire do not fall upon the earth (cf. Heidel, *Heroic Age of Science*, p. 188). Aristotle himself (*De Caelo* 284 A 24-26; cf. *Metaphysics* 1050 B 22-24) implies that the speed of the heavens was by Empedocles given as the reason for the continued suspension of the bodies in the sky (cf. page 183, note 166 *supra*).

in all directions. Such an eventuality could to his mind mean only that a single body, earth, had many "natural" motions.<sup>235</sup>

Against Empedocles Aristotle further insists that, if the elements were separated by "Strife," no reason has been given why at that time the earth should remain immobile, for the cause could not then have been the whirl. This objection again depends upon Aristotle's false assumption of a period of complete rest when "Strife" has mastered the world.<sup>236</sup> His next two objections seem to be aimed at all who used the whirl as a cosmogonic mechanism. If fragments of earth moved to the center by reason of the whirl, he maintains that there must be some other reason for the present phenomenon of the fall of heavy bodies inasmuch as the whirl is not near enough to us to affect our immediate surroundings. This is clearly no refutation, for any one who said that the eddy not only originally moved earth to the center but by its present movement still *keeps* it there must have assumed that the force of the motion still exerts influence upon the terrestrial region. Aristotle would have to support such an argument by showing that the influence of a whirling eddy, if grown too large, would not carry to the center. Even if the whirl is the cause of the falling of heavy bodies, he continues, it cannot be the cause of the upward motion of fire, his meaning apparently being that the whirl cannot be the cause of opposite motions. Consequently, since fire has a motion due to its own nature, earth must also have a natural motion. There must, in fact, have been things

<sup>235</sup> The argument for a single natural motion and rest is connected with this theory of the whirl, *De Caelo* 300 A 32-B 8. If a body is at rest at the center unnaturally, it must be constrained by something which is at rest or in motion. If the constraining body is at rest, the reasoning will fall into infinite regress unless some body is at rest *naturally*; but if the constraining body is in motion, as in the case of Empedocles' whirl which keeps the earth at rest, should the constraining force be removed, where would the constrained body move? Since it could not move on to infinity, it would have to rest somewhere, and there it would rest naturally under no constraint. Hence, each body has a place where it rests naturally and so to which it moves naturally. (In like manner he proves against the Atomists that constrained motion implies a previous natural motion, *De Caelo* 300 B 13-16; cf. pages 191 f. *supra*.)

<sup>236</sup> See page 175, note 130 *supra*.

naturally heavy and light prior to the motion of the whirl in order that, when the motion started, some objects might move to the center and others to the periphery; and the existence of naturally heavy and light bodies involves the existence, before the beginning of motion, of absolute directions, since it is by these that weight and lightness are defined.

The theory of Anaximander<sup>237</sup> which gave as the reason for the earth's continuance at the center its equilibrium, stating that what is equally removed from all extremities can move no more in one direction than in another and not being able to move in opposite directions at once must remain where it is, Aristotle praises as clever, though impossible. It is no specific reason for *earth's* rest at the center and implies that fire, too, if placed at the center, would abide there. Moreover, earth not only rests naturally at the center; it moves thither naturally which is a peculiar property of this simple body. The natural motion of fire is intimately connected with that of earth and with the place of rest for both, and all must be investigated as a single problem; but the reason for each must be specific since it is evident that the theory of Anaximander would require fire, if placed at the center, not to move in the way it does. In fact, this theory would imply that a man equally hungry and thirsty and equally distant from food and drink could not move toward either and that a hair strained with great tension, but under an equal strain throughout its length, could not break.

The natural motion of earth is a necessary and sufficient reason for the continued rest of the earth at the center of the universe, for, if earth moves naturally toward the center from all points equally and fire moves naturally away from the center to the periphery and each simple body has a single simple motion, the whole earth as well as any portion of it can be moved from the center only by force. Since no force is exerted on the whole earth greater than its own tendency to rest in its natural place, it is necessary that it should rest at the center of

<sup>237</sup> Cf. Hippolytus, *Refut.*, I, 6, 3. Plato puts the theory into the mouth of Socrates, *Phaedo* 108 E-109 A.

the universe.<sup>238</sup> This tendency of each and every part of earth to move to the center also determines the spherical shape of the earth.<sup>239</sup> Aristotle illustrates how this shape would result from the generation of the earth such as the physical philosophers represented it, substituting natural motion, however, for the constrained motion which was for them the cause of its formation. In the separation of the earthy particles out of the original mixture,<sup>240</sup> the mass which forms at the center consists of particles coming to one point equally from all directions so that every point on its surface is equidistant from the center. This means that the mass is a sphere. Even if the constituting particles do not come equally from all directions, the result would be the same, since the heavy particles push the lighter before them, all tending naturally to the center. Consequently, the mass of earth tends to be perfectly spherical, for each particle tends to the center in the sense that it tends to identify its own center with the absolute center of the universe.<sup>241</sup>

The considerations of natural motion and the consequent shape of the earth form the basis of Aristotle's refutation of Anaxagoras' explanation of earthquakes.<sup>242</sup> According to this report, Anaxagoras supposed the earth to be porous but the

<sup>238</sup> *De Caelo* 296 B 26-297 A 6. Aristotle claims that astronomical phenomena also are consistent with the geocentric theory.

<sup>239</sup> *De Caelo* 297 A 8-B 23.

<sup>240</sup> Simplicius (*De Caelo*, 543, 3 ff.) supposes Aristotle to be thinking of the description of Anaxagoras (cf. *fragments* 12, 13, 15, 17), but his description fits that of all who used the cosmic whirl as a means of constructing the cosmos by separation.

<sup>241</sup> There are added evidences of the earth's sphericity from astronomical observation (*De Caelo* 297 B 23-298 A 20); since the line bounding the darkened moon during a lunar eclipse is always curved, since a slight change of latitude on the earth causes a marked change in the position of the constellations, some which are seen in Egypt not being visible at all farther North and some setting in southern regions which never set in more northern countries, it is clear that the earth must be spherical. The rapid change in the appearance of the sky caused by a slight shifting of the point of observation on the earth leads Aristotle to assert that the earth must be very small compared with the stars.

<sup>242</sup> *Meteorology* 365 A 19-35. For the criticism of Anaxagoras' theory of lightning see page 140 *supra*.



upper part of the earth<sup>243</sup> to have been made impermeable by the action of the rains that fall upon it. The ether, or fire, getting below the earth enters its caverns and porous places and shakes it, presumably because in moving upward it finds its exit blocked. Evidently Aristotle is suppressing certain details of the theory in this report, for most of the evidence makes Anaxagoras explain earthquakes as due to the action of air rather than fire.<sup>244</sup> If in the theory both played a part, Aristotle's motive in stressing the rôle of fire becomes clear when we see that he objects that this would require a downward motion of fire which naturally moves upward. But, since Anaxagoras held that there are "seeds" of fire present in air, it is possible that he may not have introduced fire into the air under the earth by a downward motion from the great mass of "ether" above the earth. From the air which enters the cavities of the earth from below the "seeds" of fire may have been separated out by the compression which occurs in those cavities. In this way would be explained both the accounts which overwhelmingly testify that the cause of earthquakes was for Anaxagoras air and the basis for Aristotle's dissenting testimony, while the various amounts of fire released by the compression would enable Anaxagoras to explain the difference between ordinary quakes and volcanic eruptions.

Besides his objection to the downward motion of fire implied in this theory as he interprets it, Aristotle feels that the distinction required between an upper and lower part of the earth at once discredits it; Anaxagoras should have seen that

<sup>243</sup> He thought the earth was flat and rested upon air (cf. Hippolytus, *Refut.*, I, 8, 3; page 202, note 230 *supra*).

<sup>244</sup> Hippolytus (*Refut.*, I, 8, 12) says that Anaxagoras explained earthquakes as due to the shaking of the air on which the earth rides, caused by the impact of the upper air upon this air under the earth; Aëtius (III, 15, 4) says that air striking against the compact surface (of the earth) and finding no outlet shakes the enclosing portion. Cf. also Diogenes Laertius, II, 9 and Ammianus Marcellinus, XVII, 7, 11. Seneca (*Quaest. Natur.*, VI, 9, 1) likens the cause of earthquakes to that of lightning in the clouds; and from this and his report of the theory of Archelaus (*Quaest. Natur.*, VI, 12) Gilbert (*Meteorologische Theorien des Griechischen Altertums*, pp. 300-302) decides that both fire and air played equal rôles in Anaxagoras' explanation.

all parts of the earth's circumference are "down," since heavy objects move toward the earth everywhere and light objects such as fire away from it. It is also silly, he says, to say that the earth is at rest upon air due to its size and at the same time think it can be shaken throughout its whole extent when stricken from below. Finally, the theory gives no explanation of specific quakes, for not every chance region suffers from earthquakes and those regions where they do occur do not feel them at every season.<sup>245</sup>

The doctrine of natural motion necessarily involves a theory of absolute weight and its opposite, for weight and lightness are simply the names for the inherent tendency of a particular body to move in a specific way.<sup>246</sup> The proof of absolute weight like that of natural motion rests ultimately upon the observed fact that all earth falls and all fire rises.<sup>247</sup> Naturally, then,

<sup>245</sup> There is a curious extension of the doctrine of natural places and motion in *De Generat. Animal.* 737 B 27-738 A 9. There Aristotle criticizes some people who had sought to explain the movement of the semen to the testicles by saying that these organs act like cupping-glasses and that the semen as well as the other excretions are voided under the pressure of breath. Aristotle's explanation is that each excretion has its proper receptacle and, as that is its natural place, it moves to it naturally without the compulsion of any force external to itself. The theory that certain organs of the body draw moisture to themselves by reason of their similarity to cupping glasses occurs in the Hippocratic work *περί ἀρχαίας ιητρικῆς*, XXII, pp. 626-628 (Littré): αἱ σικύαι . . . τετεχνέεται πρὸς τὸ ἔλκειν ἀπὸ τῆς σαρκὸς καὶ ἐπισπᾶσθαι . . . τῶν δ' ἔσω τοῦ ἀνθρώπου φύσις καὶ σχῆμα τοιοῦτον· κύστις τε καὶ κεφαλὴ καὶ ὑστέρα γυναιξί. καὶ φανερώς ταῦτα μάλιστα ἔλκει καὶ πλήρᾳ ἐστὶν ἐπάκτου ὑγρότητος αἰεὶ. For the importance of πνεῦμα cf. Hippocrates, *περί ιερῆς νόσου*, pp. 372-4 (Littré): ὁ δ' ἐς τὸν πλεύμονά τε καὶ τὰς φλέβας ἀπὸ ξυμβάλλεται ἐς τὰς κοιλίας ἐσιὼν καὶ ἐς τὸν ἐγκέφαλον καὶ οὕτω τὴν φρόνησιν καὶ τὴν κίνησιν τοῖσι μέλεσι παρέχει. . . . In the disease, however, ἡ δὲ κόπρος ὑπέρχεται ὑπὸ βίης πνιγομένου. πνίγεται δὲ τοῦ ἥπατος καὶ τῆς κοιλίης ἀνω πρὸς τὰς φρένας προσπεπτωκότων καὶ τοῦ στομάχου τῆς γαστρὸς ἀπειλημμένου. προσπίπτει δὲ ὁκόταν τὸ πνεῦμα μὴ ἐσίῃ ἐς τὸ στόμα δσον εἰώθει. Cf. also Hippocrates, *Ἀφορισμοί*, 63 (Littré, IV, p. 556; athetized by Galen).

<sup>246</sup> Cf. *De Caelo* 307 B 30-308 A 4.

<sup>247</sup> *De Caelo* 311 B 13-29. There he says that "some" think all bodies have weight. He refers to Plato (*Timaeus* 63 E: τόδε γε μὴν ἐν τι διανοητέον περὶ πάντων αὐτῶν, ὡς ἡ μὲν πρὸς τὸ συγγενὲς ὁδὸς ἐκάστοις οὔσα βαρὺ μὲν τὸ φερόμενον ποιεῖ, τὸν δὲ τόπον εἰς δὲ τὸ τοιοῦτον φέρεται, κάτω), though he prob-



Aristotle's attempt to demonstrate abstractly that bodies which move to the center or away from it do so in virtue of their inherent weight or lightness begs the question inasmuch as he must assume for the proof that the distances covered by falling (or rising) bodies in a given time are functions of their weights (or lightness).<sup>248</sup> Absolute heaviness is defined by downward motion to the center, absolute lightness by motion away from the center to the extremity of the sphere; consequently such a definition necessitates the acceptance of absolute directions in the universe and Aristotle must attack Plato's denial of such directions at the very outset.<sup>249</sup> No one of his predecessors, he complains, had considered the question of absolute weight; they had spoken only of relative weight and lightness, but he goes further and accuses them of having thought that in their recognition of "heavier and lighter" they were really handling weight as such,<sup>250</sup> so that his criticism is from the first vitiated by his purpose of showing that they did not explain what they never meant to explain.

In this critique he is concerned exclusively with the Atomists and Plato,<sup>251</sup> for they alone seem to have advanced explanations of relative weight. Anaxagoras and Empedocles he specifically excludes,<sup>252</sup> saying that, although they did not admit the existence of a void, they gave no definition of weight. The Atomists, whom Aristotle praises to the disparagement of Plato, although the corporeality of their atoms would have given them more right to say that the weight of complex bodies depended upon size than Plato's elemental planes allowed him, recognized that some small bodies are heavier

ably would include the Atomists, since he tries to prove that they *ought* to have assigned either weight or lightness to their atoms and could not have assigned both (*De Caelo* 275 B 29-276 A 6; cf. page 213, note 259 *infra*). He then proves that, since earth sinks under all the other elements and moves to the center, it must have absolute weight, and that fire must have no weight, since it rises through the air and rises to the upper surface of all the elements.

<sup>248</sup> *De Caelo* 301 A 22-B 17.

<sup>249</sup> *De Caelo* 308 A 14-31; Plato, *Timaueus* 62 C ff.

<sup>250</sup> *De Caelo* 308 A 7-13; 308 A 34-B 3. Cf. Burnet, *E. G. P.*<sup>3</sup>, pp. 342-3.

<sup>251</sup> Plato's theory is criticized in *De Caelo* 308 B 3-29, 309 A 21-27.

<sup>252</sup> *De Caelo* 309 A 19-21.

than large ones and said that weight was determined by the amount of enclosed void.<sup>253</sup> To this Aristotle answers that at least they should add that the lighter body must contain not only more void but also less solid matter, for the body with more void, if it also have more solid matter, will not be lighter than that with which it is compared. Fire, they say, is the lightest of bodies because it has most void; but a great volume of gold must contain more void than a small quantity of fire, from which it would follow that the gold is lighter than the fire.

But even this manner of computing relative weight by comparing the ratio of void to solid in one body with the corresponding ratio in another appears to Aristotle to be inconsistent with the phenomena, because he assumes continually an absolute weight and lightness.<sup>254</sup> Since all earth falls and all fire rises, he insists that a fragment of earth, however small, must be heavier than any quantity of fire, however great. In

<sup>253</sup> *De Caelo* 308 B 30-309 A 18. Note that τὸ μείζον . . . αὐτῶν refers not to atoms but to the complex bodies (so also Simplicius, *De Caelo*, 684, 29-685, 17). The argument is that the Platonists cannot say that bodies of equal weight consist of an equal number of elementary bodies, for then all compounds of equal weight would have to have equal volumes (since there is no void); and in general it is absurd to say that bodies which have weight are composed of planes (that have no weight). But those who make the elements corporeal can with greater reason say that the larger compound body is the heavier. This neither says nor implies that the larger atom is heavier than the smaller, for the explanation would have to hold also for different volumes of the same kind, i. e. consisting of a different number of atoms of the same size. Consequently this passage, which is one of the two in which Aristotle is supposed to attribute weight to the atoms (cf. Bailey, *op. cit.*, p. 130), says nothing of the matter (cf. page 97, note 412 *supra*).

Although Democritus attributed the direction of the moving atoms in the whirl to their size and shape, the result gave the appearance of a difference in weight (Aëtius, I, 3, 18; I, 12, 6; Simplicius, *De Caelo*, 295, 5-20). It is consequently possible that Aristotle misunderstood the Atomists on this point and clear from the following argument that he would have maintained the necessity of attributing weight to the atoms if the complex bodies were to have weight. But his objection is just that the Atomists did not call the complex bodies *absolutely* heavy or light which in itself implies that they did not attribute real weight to the atoms.

<sup>254</sup> *De Caelo* 309 A 27-B 28.



the theory of the Atomists, however, a quantity of fire can be taken which will have not only more void but also more solid than a small fragment of earth, and the absolute weight of earth will be unexplained. Fire is absolutely light, so that it is always lighter than any body that has weight, that is than any body that tends to fall; but if relative weight be due to the presence of a greater amount of either solid or void, it is necessary to admit the possibility of a body lighter than what is absolutely light, since quantities of earth may be taken which have respectively more void and more solid than certain quantities of fire with which they are compared. But neither can the ratio of void to solid in a body determine its weight, for two different volumes of fire, for example, would display the same ratio; but in that case both quantities ought to rise from the center with equal speed, and this, Aristotle says, is demonstrably false. A corollary of the law of natural motion, which he believes he has drawn from observation of the phenomena, requires that of two bodies consisting of the same simple material the larger displays the natural motion to a higher degree, a large mass of fire rising faster than a small one, a large mass of earth falling more swiftly than a smaller.<sup>255</sup>

To say that objects are light because of the void in them to Aristotle can mean only that they ascend because of the void, and that requires that the void itself should have a natural upward motion while the solid moves naturally downward.

<sup>255</sup> With this is connected the law that a body moving naturally increases its velocity as it approaches its natural place (*De Caelo* 277 A 27-B 8). A satisfactory explanation of these two "facts" is never given; in fact, it is difficult to see how Aristotle could explain a difference of velocity in two different volumes of the same body, since in two bodies with the same natural motion a difference of speed in that motion can be due only to difference in the medium or to difference in the weight of the two bodies (*Physics* 215 A 25-29). But if absolute weight is determined by the *direction* of natural motion and all fire has the same direction, how can two masses of fire have different weights (since both are *absolutely* light) without which, if the medium is identical, they cannot have different velocities? Yet heavy and light are said not to be specific differentiae relative to the same simple body because fast and slow are not species or differentiae of motion, since they accompany all the different species of motion (*Physics* 228 B 28-31), which implies that the absolutely heavy can still vary in weight.

But then there is need of giving the reason why the void has this natural motion and of showing why the void and solid are not completely segregated each in its natural place. Such a motion involves finding a place for the void (though it is itself thought to be place), for, if it moves, it must change from one place to another; at the same time, since even if the void has motion it cannot be the cause of movement in the solid bodies, it leaves open the fundamental question of the prime cause of motion.<sup>256</sup>

The explanation of weight requires primary bodies the essential differentiae of which are irreducible qualities, and Aristotle argues that all systems which by quantitative differentiation derive the articulate world from a single material are refuted by their helplessness to deal with the problem of weight.<sup>257</sup> The material monists can make no more room than can Plato for absolute weight and lightness, since for them everything consists of one material differentiated only by size in some way or other.<sup>258</sup> The Atomists, if they regard their elements as two contraries, the void being absolutely light and the solid atoms heavy, still cannot satisfactorily explain how the complex bodies are lighter and heavier than one another and the primary bodies; and, if they differentiate the complex bodies only by size, since their material is identical, they also fall into the difficulties of the monists. They cannot explain absolute lightness and have to deny natural motion; they must say that a large quantity of air or fire is heavier than a small amount of water or earth.<sup>259</sup>

<sup>256</sup> Cf. the same arguments used against the theory of empty space diffused throughout matter, *Physics* 216 B 33-217 A 10 (pages 153-154 *supra*).

<sup>257</sup> *De Caelo* 309 B 29-310 A 13.

<sup>258</sup> Cf. *De Caelo* 303 B 22-304 A 7 where the monists are accused of making all individual bodies relations instead of substances.

<sup>259</sup> So in *De Caelo* 304 A 1-7 the Atomists and material monists are identified in the results of their theories. In *De Caelo* 275 B 29-276 A 16 Atomism is reduced to material monism; and all the atoms, it is proved, must have a single motion, so that either no body will have lightness or none will have weight (cf. pages 8 and 33 *supra*); then from the fact that the atoms have some kind of motion the necessity for some heavy and some light bodies is proved (cf. page 191, note 196 *supra*).



Aristotle's definition of time has already been noticed in his argument for the eternity of motion,<sup>260</sup> for, like the problems of space and weight, time is intimately connected with motion. In his elaboration of his own theory of time, however, very little attention is given to earlier discussions of the problem; he implies that his predecessors had left no theories that might serve as an introduction to his own investigation, and only two definitions of time are even mentioned to neither of which he adds the name of the author.<sup>261</sup> One of these makes time "the motion of the whole," the other the sphere itself, the first evidently referring to Plato's account<sup>262</sup> and the second to the definition attributed to Pythagoras himself.<sup>263</sup> The definition of time as the sphere of the universe Aristotle believes was arrived at by the reflection that all things are in time and also in the sphere so that the two must be the same. Zeller<sup>264</sup> suggested, however, that the definition was older than this explanation and sprang originally from the use of *χρόνος* as a symbolical name for the heavens. A similar explanation of *Χρόνος* (or *Κρόνος*) in the theogony of Pherecydes is preserved by Hermias;<sup>265</sup> it is consequently probable that the old name for the celestial sphere lingered on among the Pythagoreans without ever having been regarded as a definition of time. This is the more likely inasmuch as Aristotle elsewhere refers to another Pythagorean explanation of the nature of time,<sup>266</sup> that which represented time as being inhaled by the cosmos from the void outside; and, when he has proved that the universe is unique and perfect, he adds to his conclusion that

<sup>260</sup> Page 177 *supra*.

<sup>261</sup> *Physics* 218 A 31-B 9 (218 B 1-5 contains the refutation of Plato's definition).

<sup>262</sup> Eudemus, Theophrastus, and Alexander so understood it (cf. Simplicius, *Phys.*, 700, 18-19); Simplicius points out that it is a misunderstanding of *Timaeus* 39 B-C and calls attention to *Timaeus* 37 C-D where time is called "the moving image of eternity." (Cf. Aëtius, I, 21, 2 and I, 22, 1.)

<sup>263</sup> Cf. Aëtius, I, 21, 1; Galen, *Hist. Phil.*, 37 (*Doxographi Graeci*, p. 619, 13).

<sup>264</sup> Zeller-Nestle, *op. cit.*, I, 546, n. 1 and 545, n. 3.

<sup>265</sup> Hermias, *Irris. Gentil. Philos.*, 12.

<sup>266</sup> Aristotle, *fragment* 201.

there is neither place nor void outside of it the statement that "there is no time outside of the heaven either," evidently referring thereby to this same Pythagorean doctrine.<sup>267</sup> His refutation depends upon his definition of time as "the number of motion";<sup>268</sup> since there is no body outside of the celestial sphere, there can be no motion and so no time there. But there are further indications that even this does not give a full account of the Pythagorean theory of time, for Aristotle himself frequently refers to the belief that "the critical time" or "opportune time" was held to be a specific number<sup>269</sup> and in one passage, in the course of arguing against the Platonic construction of bodies out of planes on the ground that such a theory resolves corporeality into incorporeal points, after saying that, if time be so constructed it, too, is dissolved into nothingness because the instant is like a point, he adds that the same difficulty presents itself to the Pythagoreans who construct the nature of the world from numbers.<sup>270</sup> This does not, of course, mean that Aristotle knew directly that the Pythagoreans held time to be composed of monads or instants; it is probably only his personal development of Pythagoreanism and Platonism according to the logic of their principles, but further consideration supports the opinion that for the Pythagoreans this reconstruction unwittingly represents the orthodox doctrine. In the discussion of Zeno's paradoxes it appears that Aristotle believed Zeno to have held that time is constructed of indivisible instants,<sup>271</sup> but it has been shown that the theories which interpreted continua, whether spatial or temporal, as aggregations of units were those of Zeno's adversaries and that the paradoxes adopt the premises of these theories in order to disprove them.<sup>272</sup> Further, all evidence shows that the object of Zeno's attack was the Pythagoreans who were the adversaries of Parmenides.<sup>273</sup> We can, then, safely say that

<sup>267</sup> *De Caelo* 279 A 11-18.

<sup>268</sup> Cf. *Physics* 219 A 30-B 9.

<sup>269</sup> *Metaphysics* 985 B 30, 990 A 23, 1078 B 22.

<sup>270</sup> *De Caelo* 300 A 12-17.

<sup>271</sup> *Physics* 239 B 5-9, 239 B 29-32.

<sup>272</sup> See pages 156-161 *supra*.

<sup>273</sup> Cf. Burnet, *E. G. P.*, pp. 314-315, 320; Hasse und Scholz, *Die Grundlagen der Griechischen Mathematik*, pp. 10-12.



the Pythagoreans somehow reduced time to number, a procedure to be expected of men who claimed that "everything is number." But this has to be reconciled with the notion that time is "inhaled" into the universe from the external void, or rather breath. Now it is the limiting of this outer breath by number which produces magnitude within the universe; and it is not to be supposed that the Pythagoreans looked upon the production of time as essentially different from that of magnitude. Both are continua. Consequently, it is a misinterpretation produced by literalness to say that the Pythagoreans believed time was drawn into the universe as something previously existing outside. Outside only the unlimited, undifferentiated breath exists; when this is drawn into the universe and limited by number continua, both spatial and temporal, result. This inhaled breath it is that keeps the constituent units of continua discrete;<sup>274</sup> this is the common explanation of spatial and numerical continua which to the Pythagoreans seemed identical, and there is every reason to believe that it was also applied to time especially since Zeno obviously argues on the assumption that they treat time like space, as a continuum consisting of discrete monads.<sup>275</sup>

The definition of time, then, which Aristotle considers to be too silly to discuss and to which he restricts his account of Pythagorean theory here<sup>276</sup> was not the Pythagorean definition at all but merely a traditional symbolic name for the heavens.<sup>277</sup> Although no other theory of time is mentioned here, Aristotle elsewhere says that all his predecessors except Plato thought

<sup>274</sup> Cf. *Physics* 213 B 22-27 and Burnet, *E.G. P.*<sup>3</sup>, p. 108, n. 4.

<sup>275</sup> Cf. also Aëtius, I, 16, 1 where the "followers of Pythagoras" are reported to have held "all continua, body, space, and time" to be infinitely divisible. Though this is a later reconstruction (as is shown by the fact that it is also attributed to "the followers of Thales"), it shows that Theophrastus knew the Pythagoreans treated spatial and temporal continua in one and the same way.

<sup>276</sup> *Physics* 218 B 5-9.

<sup>277</sup> The statement of Simplicius (*De Caelo*, 512, 14-15), that the Pythagoreans called the earth a star as being an instrument of time because it is the cause of day and night, cannot be used to show that the Pythagoreans themselves thought of time as caused by earth or by the stars, for the phrase *ὡς ὄργανον καὶ αὐτὴν χρόνον* is an explanation added by Simplicius from Plato's phrase (*Timaeus* 41 E, 42 D; cf. 38 C).

time had no beginning and that Democritus even used time's eternity to prove that it is impossible to suppose that all things have been generated.<sup>278</sup> Furthermore, the notion that time is motion is discussed as if it were a common opinion<sup>279</sup> which is refuted by showing that motion takes place in specific localities while time embraces everything and every place alike and that, while all change is characterized by varying velocity, velocity is defined by time and time cannot be limited by itself either quantitatively or qualitatively.

Aristotle's own definition of time as "the number of motion as numerable" furnishes him the means of refuting a theory according to which the sounds in a concord are not heard simultaneously but seem to be so heard because the time separating them is imperceptible.<sup>280</sup> Time and sensation in time are continuous and a continuum is perceived as a whole not by means of a particular moment in the continuum; the continuous time is time only as being numbered, that is as perceived motion, so that there is no imperceptible moment, for, although time may exist *potentially* without being perceived, what then exists is only the substrate of time which is made temporal by perception.<sup>281</sup> The purpose of the argument is to establish the thesis that all quanta are perceptible.<sup>282</sup>

<sup>278</sup> *Physics* 251 B 14-19.

<sup>279</sup> *Physics* 218 B 9-20. There is some doxographical evidence even for believing that the concept of time was very early understood to be connected somehow with change and measurement. Cf. Diogenes Laertius, VIII, 84 on Hippasus; Aëtius, I, 22, 6 on Antiphon; Hippolytus, *Refut.*, I, 6, 1 on Anaximander.

<sup>280</sup> *De Sensu* 448 A 19-B 17. Cf. Archytas (35 A 18, Diels), *ἐλεγον δὲ οἱ περὶ τὸν Ἀρχύταν ἐνὸς φθόγγου γίνεσθαι κατὰ τὰς συμφωνίας τὴν ἀντίληψιν τῇ ἀκοῇ*. In *De Sensu* 439 B 19-440 A 6; 440 A 20-29 Aristotle in the same manner, by denying the existence of imperceptible moments of time and invisible spatial quanta (cf. page 5, note 18 *supra*), refutes a theory which explains intermediate colors by the juxtaposition of imperceptibly minute quantities of the primary colors. This is the theory of Democritus except that he made the primary colors four instead of two (cf. Theophrastus, *De Sensibus* 73-78). The notion that all other colors result from a mixture of black and white Theophrastus says was common (*De Sensibus* 59) and makes Empedocles agree in this, although he seems to have held four primary colors (fragment 71 appears to me to support Aëtius, I, 15, 3; but cf. Diels, *Doxographi Graeci*, pp. 50 and 222).

<sup>281</sup> Cf. *Physics* 223 A 21-29.

<sup>282</sup> Cf. pages 4 f. *supra*.

## CAUSALITY

The longest account of preceding philosophical doctrine occurs at the beginning of the *Metaphysics*. There Aristotle attempts to show that all earlier thinkers were groping for the four kinds of cause which he has himself elaborated, the material, formal, efficient, and final causes,<sup>1</sup> and that there had been no indication of any other type of causality. With such a purpose his account naturally is in detail unhistorical, for he assumes that from the first the problem of nature was met as a problem of causality and, further, that any deviation from his own doctrine must still have been a fragment of that doctrine rather than a fundamentally different conception of the problem.

Most of the early philosophers, he says, thought that the principles of all things were of a material nature,<sup>2</sup> something out of which other things are formed and into which they are dissolved but which, though changing its attributes, still remains essentially the same. For this reason they thought that nothing could really be generated or destroyed. Among these thinkers, Thales, the initiator of this cast of thought, held the principle to be water and for this reason declared that the earth rests on water. Aristotle suggests that he may have been brought to this opinion by noticing that the nourishment of all things, even fire, is moist and that the seeds of all living things have a moist nature.<sup>3</sup> The dictum of Thales Aristotle implies that he knows only by tradition; but, while he considers that tradition trustworthy, he seems uncertain about another according to which

<sup>1</sup> *Physics* II, chaps. 3 and 7.

<sup>2</sup> *Metaphysics* 983 B 6-984 A 16.

<sup>3</sup> From *De Anima* 405 B 3 it appears that Hippo may have advanced the second of these reasons. Aristotle both there and here, however, marks his statement as a conjecture. Burnet (*E. G. P.*,<sup>3</sup> pp. 48-49) thinks Thales was influenced rather by meteorological considerations. Hippo in the present passage (*Metaphysics* 984 A 3-5) is judged to be unworthy of mention among philosophers. Cf. pages 299-300 *infra*.

those who first recounted the myths about the gods held the same opinion as Thales. This clearly refers to Plato's facetious interpretation of Homer<sup>4</sup> which Aristotle seriously declares unverifiable. Anaximenes and Diogenes substituted air for water as this principle, Hippasus and Heraclitus fire; Empedocles took these three and earth besides as primary elements continuously existing and subject only to the quantitative change consequent upon aggregation into a single mass and the dispersion of that mass. Anaxagoras, older than Empedocles but later in producing his doctrine,<sup>5</sup> thought the principles infinite, saying that homogeneous bodies come to be and pass away only in the sense that their aggregation and dispersion appear to be generation and destruction; these bodies are really eternal.<sup>6</sup>

Although the two last-mentioned philosophers are presently to be credited with other principles in addition to those here given, the manner of presentation is obviously meant to imply that for all alike the material cause was the prime concern; and, while Aristotle is not here interested in identifying these material principles with his own prime matter, his tendency to do so<sup>7</sup> manifests itself in his interpretation of them as "substrates of alteration."<sup>8</sup> Moreover no distinction is noted among these various material principles; yet for the Ionians motion was an

<sup>4</sup> *Theaetetus* 152 E, 160 D; *Cratylus* 402 B.

<sup>5</sup> Ross in his commentary follows Alexander's interpretation, "inferior in the merit of his works"; but the phrase is obviously introduced here as an excuse for mentioning Anaxagoras after Empedocles despite the fact that he was the elder. Aristotle means, then, that the order he is following is chronological with respect to the doctrines but not with strict regard to the age of their authors. The relative merit of the two would not have caused him to reverse the order in his treatment.

<sup>6</sup> Aristotle's mention of water and fire does not mean to imply that these bodies were for Anaxagoras simple bodies; they are, however, for Aristotle himself examples of simple, homogeneous elements. (Cf. Ross, *Commentary on Aristotle's Metaphysics*, I, pp. 132-133, and page 108, note 444 *supra*).

<sup>7</sup> See pages 53 ff. *supra*.

<sup>8</sup> Cf. 983 B 9-10: Τῆς μὲν οὐσίας ὑπομενούσης τοῖς δὲ πάθεσι μεταβαλλούσης—12-13: τῆς τοιαύτης φύσεως αἰεὶ σωζομένης—13-16: the comparison with Socrates as subject and the states predicated of him by reason of alteration—17-18: δεῖ γὰρ εἶναι τινα φύσιν ἢ μίαν ἢ πλείους μίας ἐξ ὧν γίγνεται τὰλλα σωζομένης ἐκείνης.



essential characteristic of all matter<sup>9</sup> and for Empedocles<sup>10</sup> and Anaxagoras it was no attribute of matter as such at all. Heraclitus, on the other hand, considered it the primary characteristic of his material principle, the whole nature of which was defined by its incessant change;<sup>11</sup> his fire is hardly more than the sensible manifestation of that constant flux which is the world. It is also significant for Aristotle's method that Anaximander is passed over in silence; evidently Aristotle did not feel sure that "the infinite" was a perceptible material<sup>12</sup> such as he is here maintaining was the principle of *all* the early philosophers, and lest the exception refute his thesis, he ignores Anaximander altogether.<sup>13</sup>

The earliest of these philosophers, the Ionian monists, were not troubled by the problem of why and through what agency the variations in their several principles could be caused;<sup>14</sup> but time soon made it apparent to some, who still believed all things to be one, that the substrate could not move itself and in desperation they decided that the unity of nature is immovable in any sense whatsoever.<sup>15</sup> This assertion that the Eleatic doctrine

<sup>9</sup> Cf. Burnet, *E. G. P.*<sup>3</sup>, pp. 12 and 61; page 173, note 128 *supra*; *Metaphysics* 986 B 16-17.

<sup>10</sup> Cf. page 190, note 193 *supra*.

<sup>11</sup> *Fragments* 30, 51, 84, 90.

<sup>12</sup> Cf. pages 25-26 *supra*. In *Physics* 187 A 20-26 Anaximander, Empedocles, and Anaxagoras are grouped together on the supposition that they generate contrary qualities from a qualitatively homogeneous substrate (cf. pages 50-51 *supra*).

<sup>13</sup> Cf. A. E. Taylor, *Aristotle on his Predecessors*, p. 33.

<sup>14</sup> Later (*Metaphysics* 986 B 16-17) in contrasting Ionian and Eleatic monism he says of the former *προστιθέασιν κίνησιν, γεννῶντές γε τὸ πᾶν*.

<sup>15</sup> *Metaphysics* 984 A 16-984 B 1. In spite of the fact that the Eleatic doctrine is not susceptible to inclusion in the history of notions of causality Aristotle (*Metaphysics* 986 B 10-987 A 2) cannot resist the attempt to interpret the Unity of Parmenides as formal and that of Melissus as material, basing this deduction on the finitude of the former and the infinity of the latter. Xenophanes whom he supposes to have been the founder of the school (tradition, he says, reports that Parmenides was his pupil) does not say anything which can show in which way he meant the unity he championed to be understood (cf. page 201, note 228 *supra*), and Aristotle decides that it was with a view to the whole universe that he said the One is God. Not content, however, with regarding Parmenides' notion of unified being as a theory of being in its aspect of form,

grew from insight into the necessity of an efficient cause and concomitant inability to discover such a cause contradicts the explanation according to which the Eleatics derived both the unity and immobility of nature from the axiom that no void can exist.<sup>16</sup> The latter statement is made by way of tracing the origin of Atomism in order to produce a background for Aristotle's own doctrine of alteration and generation, the former tries to fit the Eleatics into the history of development which led to his theory of causality. But, supposing that the second part of Parmenides' poem represents his own orthodox opinion of phenomenal existence,<sup>17</sup> Aristotle can say that, inasmuch as he posited two causes there, he probably had an inkling of the efficient cause as separate from material causality, for no monist can possibly account for efficient causality but those who set up more than one primary body are enabled to use one, for example fire, as the moving cause and the others as that which is moved.<sup>18</sup> It was only later, however, that such material principles<sup>19</sup> were

he derives from the second part of the poem the notion that Parmenides, "forced to follow the phenomena," restricted the unity of being to its formal aspect and admitted that it was plural in the realm of sensation, positing here in turn two principles, hot and cold, of which he ranked the first as being, the second as non-being (cf. page 48, note 192 *supra*). The "two principles" are clearly meant to be interpreted as material and efficient cause (cf. this page, note 18 and, for another method of finding efficient cause in Parmenides' poem, page 222, note 22 *infra*). Incidentally, Burnet's claim (*E. G. P.*<sup>3</sup> p. 182, followed by Joachim, *On Coming-to-Be and Passing-Away*, p. 100) that Aristotle never meant to represent the second part of Parmenides' poem as Parmenides' own doctrine is refuted by the phrase *ἀναγκαζόμενος δ' ἀκολουθεῖν τοῖς φαινομένοις* κτλ.

<sup>16</sup> Cf. *De Generatione* 325 A 2-29, page 95, note 401 *supra*.

<sup>17</sup> Cf. *Metaphysics* 986 B 31-34 and page 48, note 192 *supra*.

<sup>18</sup> *Metaphysics* 984 B 1-8. *τοῖς δὲ* (line 5) answering to *τῶν μὲν* (line 1) is quite general and includes all material pluralists; but, since Parmenides is considered to be in one sense a pluralist though in another a monist, it includes him also (*πλὴν εἰ . . . εἶναι*, lines 3-4 should be marked as a parenthesis), and *θερμὸν καὶ ψυχρὸν ἢ πῦρ καὶ γῆν* shows that he is uppermost in Aristotle's mind (cf. *Metaphysics* 986 B 34). The word *μᾶλλον* (line 5) means that the material pluralists are *more* able than the monists to recognize an efficient cause but not yet completely capable of grasping it, since what for them acts as the initiator of motion is still really a *material* principle.

<sup>19</sup> *τὰς τοιαύτας ἀρχάς* (*Metaphysics* 984 B 8) means the various material causes already reviewed, *τὴν ἐχομένην ἀρχήν* is the efficient cause.

seen to be insufficient for generating things as they are; fire, earth, or any such thing is not likely to be the reason why things come to be and are fair and good, and it is not likely, Aristotle says, that those men thought they were. Neither is it seemly to ascribe such a state of affairs to spontaneity or chance, so that when one said, as did Anaxagoras, that the cause of the order in nature as a whole, just as in individual living beings, is mind he seemed like a sober man compared with his predecessors.<sup>20</sup> The concept, however, is not quite clear, for the same principle is made the efficient cause and the cause of the good in the world order.<sup>21</sup>

Some notion of an efficient cause might be attributed to Hesiod and Parmenides,<sup>22</sup> for they both give an important place to Love in their cosmogonies as if they saw the need of a principle which sets in motion and combines things.<sup>23</sup> This suggestion is meant only to serve as an introduction to Empedocles' treatment of causality,<sup>24</sup> for he made "Love" an efficient cause but, since there is evil and disorder as well as good and order in the world, he introduced as a separate cause of the former a second force called "Strife."<sup>25</sup> This Aristotle insists must be the real meaning of Empedocles although his inadequate expression may mislead readers; consequently in a sense Empedocles was the first to make Good and Evil first principles, since the cause of all

<sup>20</sup> *Metaphysics* 984 B 8-20. For the argument from microcosm to macrocosm cf. page 180, note 154 *supra*. The Hermotimus, who, according to Aristotle, had some claim to have anticipated Anaxagoras, is a purely legendary figure. Why Aristotle should have been misled in this matter, however, remains obscure (cf. Zeller-Nestle, *op. cit.*, I, p. 1269, n. 1).

<sup>21</sup> *Metaphysics* 984 B 20-22. The name given to the cause of motion by Anaxagoras forces Aristotle to consider it "final."

<sup>22</sup> For evidence he quotes Parmenides, *fragment* 13 (from the "Way of Opinion"), and Hesiod, *Theogony* 116-120, omitting half of line 117 and all of 118-119 (which may be spurious; cf. Rzach *ad loc.*), and reading πάντων for ἡ τοι (116) and δὲ πάντεσσι μεταπρέπει ἀθανάτοισιν instead of δὲ κάλλιστος ἐν ἀθανάτοισι θεοῖσι (120).

<sup>23</sup> *Metaphysics* 984 B 23-31.

<sup>24</sup> As is shown by his postponement of the question as to which of the two really introduced the notion, i. e. which one meant Love in the sense of efficient cause (*Metaphysics* 984 B 31-32), for the matter is not again mentioned.

<sup>25</sup> *Metaphysics* 984 B 32-985 A 10.

goods is the Good itself. Here, then, as in the case of Anaxagoras, Aristotle finds a confusion between efficient and final cause.<sup>26</sup>

Leucippus and Democritus are considered after Anaxagoras and Empedocles presumably because Atomism was later chronologically than the system of Empedocles;<sup>27</sup> but here Aristotle identifies them with the monists in so far as they recognized only a material cause. To be sure, this material cause was for them twofold, the "solid" and the "void," of which they identified the first with being and the second with non-being. But both exist equally, they claimed, and together are the cause of all things as being that out of which they are made, the differences exhibited by various objects being due to differences in the material elements just as in the monistic systems, but for the monistic mechanism of rarefaction and condensation<sup>28</sup> they substituted differences of shape, order, and position. Like the monists also, they simply neglected to explain how or why their material moves.<sup>29</sup>

The so-called Pythagoreans, who were both contemporary with the Atomists and earlier than they, being devoted to

<sup>26</sup> The "Mind" of Anaxagoras, the "Love" and "Strife" of Empedocles Aristotle interprets as efficient causes; he supposes that the terms good and evil were attached to the two forces by Empedocles, to "Mind" and matter by Anaxagoras (cf. *Metaphysics* 989 B 16-19) only as predicates, and it is this failure to abstract the Good as a final cause that he criticizes (*Metaphysics* 988 A 14-17; 988 B 6-11, 14-16). In arguing against Speusippus who made the Good the result of process, Aristotle (*Metaphysics* 1091 B 4-12) cites Empedocles and Anaxagoras along with Pherecydes as examples of those who make the generating principle the highest good. "Love" is then supposed to be the "generating principle" in the system of Empedocles; but Aristotle here distinguishes between "Love" and "Mind," calling the first an element and the second a principle, evidently because he felt that the motor forces of Empedocles were not so thoroughly immaterial as was that of Anaxagoras. On "Love" as the "generating principle" cf. pages 189, note 189; 190, note 193; 195, note 210; 196, note 211.

<sup>27</sup> *Metaphysics* 985 B 4-22.

<sup>28</sup> For condensation-rarefaction as the mechanism of all the monistic systems cf. page 118, note 482 *supra*. Aristotle attributes it even to the Atomists and Empedocles, cf. page 118.

<sup>29</sup> The Atomists are elsewhere distinguished from the Ionians in respect of their attitude toward motion; cf. page 171 *supra*.



mathematics thought that the principles of this study are the principles of everything<sup>30</sup> and seemed to find in numbers many more similarities with objects than in such things as fire, water, or earth, for justice, soul and mind, and opportunity all appeared to them to be specific modifications of number. Because they saw that the ratios and characteristics of the scales consisted of numbers and because other things seemed to have their nature modelled after numbers they supposed that the elements of numbers are the elements of all things.<sup>31</sup> The whole universe they thought to be an octave and so number.<sup>32</sup> They sought to find in the natural arrangements of the world evidence to support their theory; but, if it was lacking, they were zealous in the attempt to fit the phenomena to their prejudices, as when they invented a counter-earth to bring the total of the heavenly bodies to ten, because ten seemed to them to be the perfect number embracing the whole nature of number.<sup>33</sup> From this representation of Pythagorean theory Aristotle attempts to decide which of the four causes were recognized by it; and he is frankly puzzled, for it seems that numbers were the material of existing objects and yet that they were also the modified conditions of those objects. In short, Aristotle's feeling that numbers must have been understood as mathematical forces him to suppose that the Pythagoreans recognized number as the formal cause; and, since they talked of the even and odd as specific characteristics of number, he tries to incorporate this part of Pythagorean number theory into the "mathematical physics." This leads him to say that the universe was by the Pythagoreans constructed of the *principles* of number rather than of number itself, which conclusion he supports by attributing to them a theory of the derivation of the number series from the unit which is both even and odd, that is unlimited and limited.<sup>34</sup> At the end he

<sup>30</sup> *Metaphysics* 985 B 23-986 B 8.

<sup>31</sup> On this statement and its relation to other reports of Aristotle and the Pythagorean theory, cf. pages 44-46 *supra*.

<sup>32</sup> See *De Caelo* 290 B 12-291 A 26 and page 186 *supra*.

<sup>33</sup> On this criticism see pages 197 f. *supra*.

<sup>34</sup> The statement that the Pythagoreans generated the number series from the unit (a notion which is adapted from his own interpretation of Platonism)

admits that the Pythagoreans themselves gave no clear statement of the causal nature of their principles but that, since they said that the substance of things consisted of their principles as immanent, they evidently considered the principles as material.<sup>35</sup> Nevertheless, number as a principle still seems to him to be necessarily an expression of formal cause, and the Pythagorean notion that numbers are the material cause of objects he says arose simply from the difficulty of abstracting form from material especially in the cases where, as in man, the form never exists apart from a specifically identical material.<sup>36</sup> In such cases they decided that the form was the material and then generalized the notion, saying that geometrical figures are not *defined* by lines and continuity but lines *are* the material constituents of figures and numbers of lines, so that all things consist of numbers. Even here, however, he introduces the notion of form saying not that they consequently equated the line and the number two but that they said "the formula of the line is that of two." So he is inclined to see in the principle of number used as material an inkling of the formal cause; but there is another way in which he interprets the two causes of matter and form into this system.<sup>37</sup> The Pythagoreans made the limited and unlimited not attributes but the very substance of those things of which they were predicated and *therefore* called number the substance of everything. This is, in the first place, a reversal of the Pythagorean process, for the theory that everything is num-

betrays the nature of the report. On Aristotle's treatment of Pythagorean numbers see pages 38-40, 43-46 *supra*. The mention of the limited and unlimited as the principles of number suggests the parenthetical report of the two columns of contraries comprising ten principles (*Metaphysics* 986 A 22-B 4) headed by "limit" and "unlimited." These Aristotle ascribes to "others of the same school" and proceeds to say that Alcmaeon was either the source of this notion or else adopted it from them, but he set up no definite list of contraries, saying only that most human matters are pairs, e. g. white-black, sweet-bitter, good-bad, great-small.

<sup>35</sup> It is true, as Ross says, that the principles here mentioned (986 B 4-8) refer directly to those in the list of contraries; but, since Aristotle has established to his own satisfaction that the principles of objects are those of number, namely "limit" and "unlimited," the conclusion refers to the Pythagorean doctrine in general. Cf. *Metaphysics* 987 A 17-19.

<sup>36</sup> *Metaphysics* 1036 B 7-13.

<sup>37</sup> *Metaphysics* 987 A 13-28.



ber was most likely the primary axiom of their system, and the identification of even and odd with the unlimited and limited represents a later development.<sup>38</sup> But Aristotle further identifies the unit with the limited, that is he interprets πεπερασμένον as πέρas; and, as the limit for him suggests the form, he supposes that, when the Pythagoreans said that the constituents of things are limit and unlimited, they must have meant the second in the sense of material, the first in the sense of formal cause. The presence of an adumbration of formal cause in their thought he also finds in the fact that they began to define the essence though in a crude manner, in that their definitions themselves were superficial and that they thought the substance of a thing was the first subject to which the resulting predicate could be attached.<sup>39</sup>

The conclusion of this review of previous theories is that no type of causality other than the four Aristotle has analyzed has ever been mentioned and that all previous thinkers have groped, however vaguely, for these four.<sup>40</sup> Some have spoken of a material cause, whether as a single principle or as more than one and whether as a body or incorporeal, the Italians making it the unlimited,<sup>41</sup> Empedocles the four simple bodies, Anaxagoras the

<sup>38</sup> Aristotle's statement is due to his own reconstruction of the development of Pythagorean theory (*Metaphysics* 986 A 15-21) where, because the Pythagoreans said all things consist of numbers, he tries to make the primary principles the limited and unlimited. Cf. also page 17, note 68 *supra*.

<sup>39</sup> This "first subject" was always a number. So justice was defined as τὸ ἀντιπεπονθὸς ἄλλῳ and the first number of which this could be predicated was four. Therefore, four was the substance of justice. (Aristotle criticizes this definition in *Nicomachean Ethics* 1132 B 21-30 on the assumption that by ἀντιπεπονθός was meant strictly equal retribution in which case it neglects the proportionality of both distributive and corrective justice. It is not, however, certain that the Pythagoreans did not rather mean to express by the word reciprocal proportionality. Cf. Stewart, *Notes on the Nicomachean Ethics*, I, pp. 444-5.) See also Alexander, *Metaph.*, 38, 10-39, 17 and Ross, *Commentary on the Metaphysics*, I, p. 144.

<sup>40</sup> *Metaphysics* 988 A 18-B 21. A shorter summary occurs in *Metaphysics* 987 A 2-13.

<sup>41</sup> This view of the ἀπειρον as material cause implies that the Pythagoreans understood its contrary as formal cause. Moreover the statement ἐάν τε σῶμα ἐάν τε ἀσώματον followed by Plato's "great and small" and this Pythagorean

infinity of homogeneous bodies, others air or fire or water or something between air and fire in density.<sup>42</sup> Further, some posited an efficient cause in the form of "Love" and "Strife," "Mind," or "Eros."<sup>43</sup> Formal cause or essence, however, none has distinctly mentioned, though the Platonists come nearest to doing so;<sup>44</sup> and the final cause, too, has never been recognized as such, that is as the end for the sake of which motion, change, and activity occur. Those who set up "Mind" or "Love," to be sure, consider these causes to be "good," but they intend them as efficient and not as final causes with the result that they consider the Good to be a cause only accidentally and not in itself.<sup>45</sup>

This résumé calls for a general criticism of the preceding doctrines from the point of view of causality. The material monists<sup>46</sup> fail to account for incorporeal existence<sup>47</sup> and, while

principle after which come Empedocles, Anaxagoras, and the material monists means that Aristotle views the ἀπειρον here as incorporeal. He identifies the unlimited with the κενόν (cf. page 17 *supra*) and treats this κενόν as empty space, whereas the Pythagoreans thought of it as a subtile material, "breath" (cf. pages 24, note 88 and 25, note 95 *supra*).

<sup>42</sup> Cf. page 49, note 199 *supra*.

<sup>43</sup> The last refers to the dubious interpretation of Hesiod and Parmenides in *Metaphysics* 984 B 23-31 (page 222 *supra*).

<sup>44</sup> Yet Aristotle has claimed to find a recognition of formal cause in Parmenides (cf. page 220, note 15), the Pythagoreans (cf. pages 224 ff.), and also in Empedocles (*Metaphysics* 993 A 17-18). In *Metaphysics* 1078 B 12-30 the Pythagoreans and Democritus are said to have attempted universal definitions to a certain extent, the former connecting their definitions with numbers, the latter defining hot and cold in a way (cf. Theophrastus, *De Sensibus*, 68; Simplicius, *De Caelo*, 564, 24-29); and in *Physics* 194 A 20-21 and *De Part. Animal.* 642 A 26-29 Democritus is reported to have touched on formal cause, in the former passage being associated in this respect with Empedocles.

<sup>45</sup> Elsewhere by supposing that in the system of Empedocles "Love" is the prime generating principle, Aristotle argues that Anaxagoras and Empedocles by setting up such principles vaguely recognized the necessary primacy of the final cause (cf. page 223, note 26). In *Metaphysics* 988 B 11-14 the One and Being of the Platonists, although called the Good, is said to be so only incidentally and so to be rather formal than final cause.

<sup>46</sup> *Metaphysics* 988 B 22-989 A 18.

<sup>47</sup> The accusation is generalized in *Metaphysics* 1075 B 13-14: No one explains why some things are perishable and others immortal, for they all produce everything from the same principles. But (*Metaphysics* 1075 B 24-27)



seeking to give the causes of generation and destruction and a physical explanation of everything, they remove the very possibility of motion by omitting the efficient cause.<sup>48</sup> Nor do they assign essence as the cause of anything. Even the off-hand way in which they say that some one of the simple bodies is the principle is reprehensible, for the manner in which these are generated from each other, some by concretion and others by segregation, should have bearing on which is considered prior. In one sense the most subtle ought to be primary, since that

there must be other things beside the sensible existences or there will be no principle at all or order or generation or heavenly movement (for these all depend ultimately upon a prime mover which is the primary eternal substance) and every principle will presuppose an antecedent principle as in the systems of the theogonists and physical philosophers (cf. *Metaphysics* 1072 A 19-22). Some indeed (i. e. Hesiod) went so far as to create the world out of non-Being (Aristotle stresses the literal wording of *Theogony* 116-117; but cf. *Metaphysics* 1000 A 9-19) and others (the Eleatics) in order to avoid that shift said that everything is one (*Metaphysics* 1075 B 14-16).

<sup>48</sup> In *De Generatione* 335 B 7-336 A 14 Aristotle insists that the forms and matter as presented in Plato's *Phaedo* are not sufficient to explain generation and destruction. There is a third cause, the efficient cause, which "all have seen as in a dream but none has explained" (but see pages 235, note 82, and 245 *infra*). He opposes to the doctrine of the *Phaedo* the theory that the movement of matter arises from matter itself, intending this to be a general statement of the attitude of all the Presocratics. For the Atomists and Ionians it is a sufficient statement, and, since after the original impulse of "Mind" in the system of Anaxagoras matter is moved by other matter in motion—at least so Aristotle and Plato understood (cf. *Phaedo* 98 B ff.)—, it may do for Anaxagoras; it is, however, not correct with respect to Empedocles save in so far as he gave no analytical description of the efficient cause such as Aristotle considers necessary. This explanation, Aristotle says, is more scientific than that of the *Phaedo*, for that which alters another thing is more the cause of generation than is the form; but matter is passive and mobile, and activity and motivity must belong to some other faculty. A separate efficient cause is required and also a formal cause neither of which the materialistic theory provides. The material forces which they attribute to bodies are the *instruments* of generation and destruction, for they say that everything arises and passes away because the hot *naturally* divides and the cold brings things together and every other body has some active or passive nature. But Aristotle objects that fire not only moves but is moved and that these bodies are not only the causes but the material of generation and destruction. Moreover how can they be instrumental of anything when there is no formal cause recognized and so no purpose? These

would be the first from which the others arise by combination; this reasoning would support those who make fire the principle,<sup>49</sup> and it was evidently a feeling that the element of corporeal objects must be subtle, Aristotle conjectures, that prevented all these thinkers from making earth the principle<sup>50</sup> although each of the other three bodies found its partisan. But this argument could not support air or a body midway between water and air in density or any body except fire. On the other hand, the reason for not making earth an element is obscure; the common opinion is that all things are earth and Hesiod says earth was the first of bodies. In fact, water would be prior to air and earth to water on the argument that what is later in generation is prior in nature<sup>51</sup> and that what is concocted, that

forces are reduced to something less than instrumentality if there is no higher cause to which they are auxiliary. The specific materialism combatted in the final lines was that of "the followers of Parmenides" according to Alexander (Philoponus, *De Generatione*, 287, 26). Joachim accordingly takes it to be Pythagoreanism, because Aristotle elsewhere (*De Generatione* 318 B 6-7, 330 B 13-19) attributes to Parmenides (i. e. from the second part of the poem) the two principles, fire and earth. But when in *De Generatione* 329 B 26-30 he combats the notion that fire divides, saying it combines homogeneous objects and only incidentally divides others, he implies that the objectionable opinion was widely held; Aristotle himself attests that the Atomists as well as Plato so believed (*De Caelo* 307 A 16-B 10), Theophrastus attributes it to Democritus and the Pythagoreans (*apud* Simplicius, *De Caelo*, 564, 24-29) and elsewhere uses it as a commonly accepted opinion (Theophrastus, *De Sensibus* 54), and Plato suggests the same thing (*Cratylus* 412 D-413 B). Moreover, the present passage does not represent the hot and cold as the only material forces (this was the theory of Archelaus, too, among others; cf. Hippolytus, *Refut.*, I, 9, 2). The whole must be taken as a general account of all materialistic systems.

<sup>49</sup> Cf. *De Caelo* 303 B 13-22 and pages 12-14 *supra*.

<sup>50</sup> Cf. Burnet, *Greek Philosophy*, Part I, pp. 26-27. Some doxographers, however, make earth the element of Xenophanes (cf. Aëtius, I, 3, 12 against which Galen protests; cf. Diels, *Vorsokratiker*, 11 A 36). Although Aristotle elsewhere says that some considered earth to be the sole element (*Physics* 193 A 21, *Metaphysics* 1014 B 33), it has been claimed that the limiting phrase in the present passage, οὐδεὶς τῶν ὑστερον, saves him from self-contradiction. This implies either that he did not consider Xenophanes' material principle to be earth (for Xenophanes is later than the Ionians included in τῶν ὑστερον) or that he thought Xenophanes posited more than one element (N. B. τῶν ὑστερον . . . καὶ ἐν λεγόντων).

<sup>51</sup> Cf. *Metaphysics* 1050 A 3-10, *Physics* 261 A 13-14.

is compounded, is later in generation. It is, however, chiefly the failure of all his predecessors to give a reason for generation and particularly for continuous generation in this world that Aristotle criticizes;<sup>52</sup> even those who posit two causes require a still more sovereign cause, the cause, Aristotle means, that will assure the permanent activity of the universe, the final cause which is pure actuality.<sup>53</sup>

Those of the Presocratics who recognized two kinds of causality most distinctly were Empedocles and Anaxagoras; but Aristotle believes that even they were unaware of the import of their own words, for he finds that they made only sparing use of the distinct concepts of material and efficient cause.<sup>54</sup> Matter itself as conceived by Empedocles presents special difficulties, for he really posits four separate material causes (just as he divides the efficient cause into two), each of which has immutability; yet experience shows that his four "eternal roots" do arise from one another and, besides, the theory that denies such generation and destruction removes the possibility of alteration, inasmuch as without a single substrate for contrary qualities there could be no change from hot to cold or from cold to hot.<sup>55</sup> The material cause, then, must be a single substance; but Empedocles was not even consistent in making it quadruple, for Aristotle believes that, although he was the first to call the elements four, he used them rather as a single contrariety opposing fire on the one hand to earth, water, and air as a single principle on the other.<sup>56</sup> Similarly, Aristotle objects, the division of efficient

<sup>52</sup> *Metaphysics* 1075 B 16-19.

<sup>53</sup> Ross takes *τοῖς δύο ἀρχαῖς ποιοῦσιν* (1075 B 17-18) to refer to "nearly all" of Aristotle's predecessors. But I think the "two principles" here are not the "contraries" ascribed to all philosophers in 1004 B 30 and 1075 A 28. The *καὶ* certainly makes the following words more specific than the preceding sentence, and the "two principles" are, on the one hand, the material and pseudo-efficient causes of Anaxagoras and Empedocles, on the other, the material and formal causes of Plato. The *eternal* change can be explained only by that cause which is at once efficient, formal, and final; and it is particularly the final aspect which Aristotle thinks no one has even adumbrated.

<sup>54</sup> *Metaphysics* 985 A 11-18.

<sup>55</sup> *Metaphysics* 989 A 20-30. Cf. pages 59-60 and 96, note 405 *supra*.

<sup>56</sup> *Metaphysics* 985 A 31-B3. Cf. pages 56 f. *supra*.

causality into two separate forces is not plausible.<sup>57</sup> Empedocles makes more use of efficient causality than does Anaxagoras, yet even he does not use it sufficiently or consistently, for "Love" divides the single elements though it brings all things together into unity and "Strife," while segregating the elements from the *Sphere*, combines the parts of each separate element.<sup>58</sup> "Love" and "Strife" are opposed to each other; this opposition implies a contrariety according to which the activities and not merely the results of the two forces ought to be essentially contrary,<sup>59</sup> a consideration which affects Empedocles only because Aristotle misunderstands the definition of the two forces in his system. They are forces which act not within any one "root" but only among the roots considered as separate units.<sup>60</sup> Aristotle, however, insists that "Strife" is essentially the cause of destruction in Empedocles' system and then attempts to show that this definition is inconsistent with the result of the activity of "Strife" in the cycle.<sup>61</sup> Everything except the *Sphere* is, in fact, generated by "Strife," a conclusion which he seeks to support by a misinterpretation of Empedocles' words<sup>62</sup> and by what he considers the consistency of the system inasmuch

<sup>57</sup> *Metaphysics* 989 A 25-26.

<sup>58</sup> *Metaphysics* 985 A 21-31.

<sup>59</sup> The extent to which the notion of contrariety implied for Aristotle interaction appears in *Metaphysics* 1092 B 6-8. There he has been arguing against the Platonic derivation of numbers as inconsistent with the imperishability of number. The contrary, whether present in the compound or not, destroys it, he says, as "Strife" destroys the mixture. Then he adds: "But 'Strife' ought not destroy the mixture since it is not contrary to it." The implication is that "Strife" and "Love" ought somehow react upon one another; but when he wants to identify the *Sphere* with his own prime matter he points for support to the fact that "Strife" and "Love," being contraries, affect not each other but some third thing (*Physics* 189 A 24-26, page 53 *supra*).

<sup>60</sup> See page 190, note 193 *supra*.

<sup>61</sup> *Metaphysics* 1000 A 24-B 3, 1000 B 9-12.

<sup>62</sup> He quotes Empedocles, *fragment* 21, lines 9-12 with *ἐξ ὧν* instead of *ἐκ τούτων* (and other slight changes), which words refer to the four roots alone. Yet even as Aristotle takes the phrase (including "Strife") it would include "Love" as well as "Strife" and could support his interpretation only with the help of the further misconception that "Love" and "Strife" work independently upon the elements (cf. pages 188-190 *supra*).



as, if there were no "Strife" in things, all would be united;<sup>63</sup> this, however, overlooks the fact that not only "Strife" but also "Love" must be present for the formation of an organic world. Since "Love" also in creating the *Sphere* destroys all else, both forces are equally causes of existence and destruction.<sup>64</sup>

From the difficulty of explaining why some things are perishable and others not Aristotle releases Empedocles who, he says, is at least consistent in pronouncing everything but the elements perishable.<sup>65</sup> The cause, however, for the alternate dominance of the two efficient causes Empedocles does not give except to say that it naturally so happens;<sup>66</sup> he speaks of the forces as being bound by a great oath<sup>67</sup> implying that the alternation is necessary, but he gives no cause for this necessity. Aristotle here is hinting at the necessity for a final cause which he elsewhere suggests that Empedocles dimly recognized when he made "Love" the Good; yet this force is a principle both as efficient and as material, Aristotle claims, for it not only brings things together but is also part of the mixture.<sup>68</sup> He grants the possibility that one thing may happen to be both efficient and material cause, but even in such a case the essence of the two causes is not the same, and it is not clear in which sense "Love" is a principle.<sup>69</sup> Empedocles, of course, did not attach laudatory epithets to "Love" by way of implying that it was a final cause;

<sup>63</sup> From *fragment* 36 he quotes *ἐσχατον ἰσχυρο νεῖκος* to support his premise that in the *Sphere* there is no "Strife."

<sup>64</sup> Since there is no "Strife" in the *Sphere*, Aristotle makes the following parenthetical criticism (*Metaphysics* 1000 B 3-9): Empedocles seems to call the *Sphere* a god (cf. *fragment* 31); Aristotle, identifying it with his own god, complains that this god would be less wise than other beings, for he has no "Strife" in himself and, since Empedocles says knowledge is of like by like (he quotes *fragment* 109), can consequently have no knowledge of "Strife." It is evident that Aristotle here is inclined to interpret the *Sphere* as a final cause; Empedocles, however, seems to have used the name of god for many things beside the *Sphere* and especially of the elements (cf. *fragments* 21 and 23, Aëtius, I, 7, 28) which would have been quite in the Ionic tradition (cf. Zeller-Nestle, *op. cit.*, I, 974). The criticism is at any rate inappropriate from one whose god knows only himself (*Metaphysics* 1072 B 20 ff.).

<sup>65</sup> *Metaphysics* 1000 B 17-20.

<sup>66</sup> *Metaphysics* 1000 B 12-17.

<sup>67</sup> Aristotle quotes Empedocles, *fragment* 30 with slight variations.

<sup>68</sup> *Metaphysics* 1075 B 1-7.

<sup>69</sup> Cf. page 108, note 444 *supra*.

but, once Aristotle has so interpreted the matter, the position of "Strife" is troublesome, for "Strife" is immortal just as "Love" is. Consequently Aristotle has to attack this notion and insist that "Strife" cannot be immortal inasmuch as it is the nature of evil itself.<sup>70</sup> It is his own belief that evil cannot exist among the eternal principles.<sup>71</sup> In the case of individual things which come to be, grow, and perish, the final cause of generation and growth is the formal cause;<sup>72</sup> but Empedocles seems to make growth merely addition of mass saying "fire increases by fire."<sup>73</sup> This explanation of growth Aristotle says is obviously inadequate;<sup>74</sup> the problem of natural generation, however, must be still more difficult, for the uniformity of generation requires a cause that Empedocles fails to assign, although he himself recognizes that it is not mere combination which results in a given substance such as bone but a certain kind of combination, combination in a definite proportion.<sup>75</sup> Thus much, then, he seems to recognize, but none of his principles can be the cause of this proportion of combination, not the material roots certainly nor even "Love" and "Strife," for they are the causes of aggregation and segregation only. Yet, Aristotle goes on, the essence of each thing consists just in that

<sup>70</sup> In *Metaphysics* 985 A 4-7 Aristotle implies that "Love" and "Strife" do not seem to be the causes of good and evil respectively in Empedocles' poem only because the author could not express himself clearly but that this must have been his meaning.

<sup>71</sup> Cf. *Metaphysics* 1051 A 17-21.

<sup>72</sup> Cf. *De Generatione* 335 B 5-7.

<sup>73</sup> *De Generatione* 333 A 35-B 20. Aristotle quotes Empedocles, *fragment* 37.

<sup>74</sup> He has already discussed growth in *De Generatione* I, chap. 5; see especially 321 B 19-322 A 4: it is the embodied form that grows, not the material body itself (cf. page 312 *infra*).

<sup>75</sup> In *De Anima* 410 A 1-6 Aristotle quotes Empedocles, *fragment* 96, lines 1-3 to prove that he knew the importance of the formula of combination for the distinct character of individual objects. In *Metaphysics* 993 A 15-24, as evidence for his contention that all four causes had been vaguely recognized in the past, he refers to this same statement of Empedocles and identifies the *λόγος* or ratio of mixture in the production of bone with the essence or formal cause. He implies, however, that Empedocles did not explicitly generalize the conception, for he says that the ratio must be the essence of everything or nothing and that it is in virtue of this, the formal cause, that each thing exists and not because of the matter as Empedocles says (cf. also *De Part. Anim.* 642 A 18-24).

cause of its definite proportion of mixture and not in mere "mixture and separation of what has been mixed."<sup>76</sup> The name given to these last is chance not proportion,<sup>77</sup> for mixture can occur in any way whatsoever. Empedocles said nothing at all about the specific formula which is the cause of each naturally existing thing and its own essential nature. This is also the good for each thing, that is its final cause; but he praised only mixture in general. Significantly the criticism here is not that Empedocles confused the final and efficient causes, for in Aristotle's system also the final, formal, and efficient causes of the individual are identified, but that he mistook the final cause—and also the specific efficient cause—because he slighted the form.

The distinction of two modes of reality, Mind and Matter, is even sharper in the system of Anaxagoras than it is in that of Empedocles. The principle called by Anaxagoras *νοῦς* Aristotle usually interprets as that of efficient causality; his chief criticism of it lies in the sparing and arbitrary manner in which it is applied to the explanation of change and movement,<sup>78</sup> an objection which Aristotle repeats after Plato.<sup>79</sup> This principle, he complains, Anaxagoras used, like the machine in the theater, to get the construction of the world started; he dragged it in when he was unable to explain why the universe necessarily exists, but otherwise he made anything rather than this the cause of what occurs. This objection is valid in so far as *νοῦς* was evidently only the initiating cause of movement, the individual motors in the world of change being sections of that matter the actual motion of which was induced by other matter in mo-

<sup>76</sup> Quotation from Empedocles, *fragment* 8.

<sup>77</sup> Aristotle here parodies line 4 of *fragment* 8: *φύσις δ' ἐπὶ τοῖς ὀνομάζεσθαι ἀνθρώποισιν*. From *De Generatione* 333 B 13-15 it appears that Aristotle understood *φύσις* in this line to be equivalent to *οὐσία* (and took *ἐπὶ τοῖς* to refer to *μῖξις τε διάλλαξις τε*). He supposed, then, that Empedocles meant to say that what is called essence is simply mixture and segregation. Having shown that essence is rather proportion, i. e. the formal cause, he replies, "obviously mixture and separation are called chance and not proportion (*λόγος*) and consequently not essence (*οὐσία*)."<sup>78</sup> Cf. page 243, note 114 *infra*.

<sup>78</sup> *Metaphysics* 985 A 18-21.

<sup>79</sup> *Phaedo* 98 B-C.

tion.<sup>80</sup> Inasmuch as all motion, however, is ultimately due to the impulse of Mind, the latter is the primary efficient cause; but it is not the proximate cause of any movement other than the original motion of the whirl. Consequently it is not identical with the specific efficient causality of Aristotle,<sup>81</sup> and it is obviously impossible to label it either efficient or final. This recalcitrance of a principle that is not exactly equivalent to any of his own forms of causation allows Aristotle to criticize it first as if it had been meant to be efficient causality and then as if it had been intended as final cause. Anaxagoras made the Good a principle as motive, he argues, for the movent is Mind. Suppressed but essential to this criticism are the assumed intentions deduced from the name this principle bears, for to Aristotle it is evident that Mind or Intelligence must have been thought of as the Good. If, however, Intelligence sets the world in motion, it must do so for some purpose which is other than itself; in short, there must be a final cause apart from motive Intelligence.<sup>82</sup> The mere statement that Anaxagoras had not recognized a final cause would have been unimpeachable. To complain that he identified final and efficient causality in the *νοῦς* is not only unhistorical but also inappropriate for Aristotle whose God, pure intellectual activity, is at once the efficient and final cause of the movement of the universe.<sup>83</sup> It is still more

<sup>80</sup> Cf. Anaxagoras, *fragment* 13: *νοῦς withdraws* from what it has once set in motion and the moving eddy continues the process of separation begun by the moving impulse of *νοῦς*.

<sup>81</sup> There is, besides, the added characteristic of "knowledge" which Anaxagoras gave to this principle and which naturally caused Aristotle to see a similarity between it and his own final cause (cf. Anaxagoras, *fragment* 12 and page 222, note 21 *supra*). Yet it seems that Anaxagoras' notion is more nearly deterministic than teleological.

<sup>82</sup> *Metaphysics* 1075 B 8-11. Aristotle admits that in his system final and efficient cause may be the same. The medical art—for example—in the mind of the physician is the efficient cause of the health to be produced in the patient; the health of the patient, however, is the final cause, and the efficient cause of the doctor's action is identical with the final cause, both being the form of health. Cf. *Metaphysics* 1034 A 21-30.

<sup>83</sup> Aristotle here adds an highly ambiguous objection to the fact that Anaxagoras posited no contrary to the Good, i. e. Mind. Elsewhere (cf. page 223, note 26) Good and Evil as principles are ascribed to him, the opposition being



extraordinary to find Aristotle trying to identify *voûs* with the form, an interpretation in which he is aided by his habitual identification of the mixture or precosmic state of Anaxagoras with his own prime matter.<sup>84</sup> Anaxagoras himself did not expressly indicate that he was positing two elements,<sup>85</sup> Aristotle admits; but he would have granted that to be in accord with his intentions had anyone developed the implications of his system. One of these principles was matter, his description of which Aristotle says was absurd in itself but showed that he was, nevertheless, near the truth. The universal primeval mixture of which Anaxagoras talks is impossible on three grounds, he asserts. First, it implies a previous state in which the things to be mingled were unmixed; this is a purely verbal argument the very opposite of which Aristotle uses to show that precosmical motion is impossible in which procedure he praises Anaxagoras for beginning with an immobile mixture.<sup>86</sup> Again, it is impossible for a mixture of any two chance objects to occur; consequently not everything can be mixed together, a conclusion which is valid for *μῆξις* in Aristotle's sense of chemical combination but as applied to the mechanical mixture of Anaxagoras only betrays a misunderstanding of the theory.<sup>87</sup> Finally, such a notion implies the separability from substance of qualities and accidents; this objection like the preceding depends upon the

interpreted as that of Mind and Matter. This opposition which Aristotle thus sees implied in the distinction between Mind and the mixture Anaxagoras did not himself indicate; but, further, the captiousness of Aristotle's criticism is emphasized by the fact that he elsewhere argues that evil cannot be a first principle and uses this axiom to combat the "immortality of 'Strife'" in the system of Empedocles (cf. page 233 *supra*).

<sup>84</sup> *Metaphysics* 989 A 30-B 21.

<sup>85</sup> Ross supposes that by using the term *στοιχεῖα* here of Anaxagoras' two principles Aristotle intends to imply that Mind for Anaxagoras was material. But Aristotle intends to prove that by Mind Anaxagoras meant formal cause which he never thought of as material; *στοιχεῖον* here is used rather in the sense in which it occurs in *Metaphysics* 1070 B 22-35 where the three *στοιχεῖα* are called form, privation, and matter. This lends point to the comparison of Anaxagoras with Plato, in that Aristotle claims that Plato too, while recognizing form and matter, neglected privation (cf. *Physics* 191 B 35-192 A 12).

<sup>86</sup> *De Caelo* 301 A 11-20; cf. page 194 *supra*.

<sup>87</sup> Cf. pages 141-143 *supra*.

anachronistic assumption of a distinction between quality and substance, an assumption related to Aristotle's constant tendency to impute to the Presocratics the notion of qualitative change.<sup>88</sup> Despite these criticisms, however, the fact that in the unseparated mixture nothing existed separately means for Aristotle that it had no attributes of quality or quantity, in other words that Anaxagoras was aiming at the Aristotelian concept of primary matter. There is one thing, however, Mind, which is "unmixed and pure"; and this, standing in opposition to the "mixture," seems to Aristotle to be essentially the same as the opposition of the One and the Other, the Platonic contrariety which he then identifies with his own pair of causes, the form and the unformed matter.<sup>89</sup> The result of this interpretation, which makes the *voûs* the formal cause, if taken in connection with the previous passages on Anaxagoras, produces a startling identification of this principle with the God of Aristotle, an identification which Aristotle himself never expressly makes although he must have been aware of it, for he has found in the *voûs* the combination, however vaguely expressed of the efficient, final, and formal phases of causality.

The Pythagoreans are set apart from all of these philosophers and treated as more closely related to the Platonists because they appear to have been concerned as well with imperceptible as with perceptible being, whereas the thinkers so far considered restricted their attention to generation, destruction, and motion in general.<sup>90</sup> The Pythagoreans, however, appear to Aristotle to stand midway between the physical philosophers and the thinkers who followed Socrates, for, although the principles they assumed were non-sensibles and so more fit to ex-

<sup>88</sup> Cf. page 52 *supra*.

<sup>89</sup> In *Metaphysics* 991 A 13-19 (repeated with slight verbal changes in *Metaphysics* 1079 B 18-23) Aristotle identifies Eudoxus' theory of immanent ideas to explain the qualities of an object with the theory of Anaxagoras that the nature of an object is due to the preponderance in it of a certain kind of "seed." He implies, however, that Anaxagoras explained essence as immanent quality, which is anachronistic; but, if a theory of essence is to be constructed at all for Anaxagoras, this is much nearer to his own beliefs than the notion of formal cause.

<sup>90</sup> *Metaphysics* 989 B 21-27.

plain the higher realms of Being, they applied those principles exclusively to the purpose of generating the world and explaining the physical phenomena, so that their method implies that they, like the physical philosophers, believed that only the perceptible world is real.<sup>91</sup> The difficulty Aristotle here expresses concerning the Pythagorean system, like so many of the special inconsistencies in his reports of that system, is the result of his inability to understand that for the Pythagoreans numbers were not mathematical concepts but physical entities.<sup>92</sup> A theory which posits even and odd, the limit and the unlimited as the only principles<sup>93</sup> would be at a loss to explain the possibility of motion; yet the Pythagoreans offer no efficient cause and do not tell how genesis, destruction, and the movement of the heavenly bodies, all of which they treat as real, are possible without motion and a cause of motion.<sup>94</sup> Even as material cause, however, number will not fulfil the necessary functions,<sup>95</sup> for, apart from the fact that magnitude cannot be generated from the elements of number,<sup>96</sup> the physical properties of bodies cannot be explained by such principles; but the Pythagoreans had nothing specific to say of sensible bodies as such and so omitted all explanation of qualitative difference just because they thought their principles accounted for sensible as well as mathematical bodies. This statement is correct, but the reason for the Pythagorean assumption here criticized is that the concept of incorporeal geometrical extension had not occurred to the Pythagoreans; Aristotle, on the other hand, insists that qualitative differentiation cannot be derived from quantification,<sup>97</sup> a process which must be assumed if sensible bodies are to be constructed of numbers. Moreover, Aristotle objects,<sup>98</sup> if number is the material cause of the universe itself and there is just this one

<sup>91</sup> *Metaphysics* 989 B 29-990 A 8.

<sup>92</sup> Cf. page 43 *supra*.

<sup>93</sup> Aristotle means that these, as the elements of number, are the basic principles of everything, since everything is composed of number. Cf. page 224, note 31 and note 34 *supra*.

<sup>94</sup> *Metaphysics* 990 A 8-12.

<sup>95</sup> *Metaphysics* 990 A 12-18.

<sup>96</sup> Aristotle does not here give the arguments against this assumption. But see pages 39-40 *supra*.

<sup>97</sup> Cf. pages 8 ff.

<sup>98</sup> *Metaphysics* 990 A 18-29.

kind of number, it cannot also be the cause of the events in the universe; in short, the Pythagoreans should have seen that number as formal cause and as material cause must be essentially different. This necessity for two specifically different kinds of number, even if number be considered the sole element, Aristotle enforces in another fashion by referring to the fact that the Pythagoreans defined as number not only the physical parts of the universe but also such abstractions as opinion, opportunity, injustice and localized them in the cosmos on the assumption that every number has its proper position.<sup>99</sup> Then, if the numbers which constitute these abstractions are not of a different order from those of which material bodies consist, there can be no difference between corporeal bodies and abstract realities. This particular theory of the Pythagoreans seems to him to imply a difference between abstract and concrete number, the first of which might then be considered as formal, the second as material. This, Aristotle says, is the way that Plato conceived the matter, distinguishing between intelligible and sensible numbers;<sup>100</sup> consequently it is natural that, after arguing against the genesis of the number series in the philosophy of Speusippus and Plato,<sup>101</sup> he should set forth the difficulties which attach to the Pythagorean identification of numbers and objects. This he does by showing that number can be the cause of things in no one of the four senses of cause.<sup>102</sup> He mentions two ways in which number might have been taken to be the cause of substance, one the method of Eurytus<sup>103</sup> who imitated the outline of living things with pebbles, just as numbers are reduced to triangles and squares,<sup>104</sup> and so attached a certain number to

<sup>99</sup> Alexander (*Metaph.*, 75, 15-17) says that Aristotle treated this doctrine in the second book of his work on the Pythagoreans.

<sup>100</sup> *Metaphysics* 990 A 30-32.

<sup>101</sup> *Metaphysics* 1092 A 21-B 8.

<sup>102</sup> *Metaphysics* 1092 B 8-1093 B 21.

<sup>103</sup> Theophrastus, *Metaphysics* 6 A 19 ff. (Ross and Fobes) reports this method of Eurytus on the authority of Archytas.

<sup>104</sup> This method is referred to Pythagoras himself; it was certainly older than Eurytus whose symbolism was apparently an extension of it. Cf. Heath, *A Manual of Greek Mathematics*, pp. 43-50; Burnet, *Greek Philosophy*, Part I, pp. 52-54.



each, which amounts to considering the numbers as limits, the second that of considering man and everything else to be a ratio just as the octave is. To the first method Aristotle objects that the qualities cannot be represented by numbers and so cannot be numbers; to the second he replies that it makes the numbers matter, since the essence or formal cause will be the ratio.<sup>105</sup> The number is merely the measurement of definite objects in the mixture; the essence is the relationship of these quantities and so the formal cause of the mixture of numbers whether they be corporeal or not. It is not number, then, that is the material cause but the numbered matter; the Pythagoreans, however, looked upon matter as a construction of numbers, since for them abstract numbers did not exist.

The advantage which is supposed to accrue to things from being mixed in an expressible ratio does not always follow, Aristotle says; in some cases it is better that a potion be well diluted than that it represent any definite ratio. But the Pythagorean expression of ratios is wrong anyway, for the ratio of a mixture consists of the addition of numbers not of multiplication,<sup>106</sup> for otherwise any two bodies the numbers of which are divisible by the same factor would be only greater and smaller amounts of the same thing,<sup>107</sup> a patent absurdity for Aristotle who assumes that the qualitative differences of two bodies are irreducible. If, now, all things share in number, it will be necessary that many things be designated by the same kind of number, square or cube, equal or double. But if number is the cause of the object's nature, all things that share the same kind of number will be the same, which is absurd.<sup>108</sup> The notion that

<sup>105</sup> The example given: flesh or bone is number only in the sense that the formula is "three parts of fire and two of earth" is probably a reference to Empedocles, *fragment* 96, although this is not the proportion given by Empedocles.

<sup>106</sup> Aristotle implies that the Pythagoreans said *τῶν τρία* and *τῶν δύο* instead of *τρία πρὸς τρία* and *τρία πρὸς δύο*.

<sup>107</sup> For example, if the formula of fire were  $2 \times 5 \times 3 \times 7$  and of water  $2 \times 3$ , fire would be only 35 units of water or both fire and water would be different amounts of the unitary substance represented by 2 or by 3.

<sup>108</sup> That all things can be designated by number, such as the motions of sun and moon, the span of every animal's life, presents no difficulty so long as

the numbers are causes Aristotle says arose from the observation of certain analogies<sup>109</sup> which are easy enough to find; the Pythagoreans, in attaching importance to such observations, he compares with the ancient Homeric interpreters<sup>110</sup> who overlooked important resemblances in seeing trivial ones. At most they show that the good attaches to numbers accidentally inasmuch as it is found in one column of the contraries along with the odd, straight, square, and certain characteristics of number; the seasons, being four, for example, have the square number four as an accident not as a cause of their being. So the straight line may be said to correspond to the flat surface, white color, and even perhaps odd number but only by analogy.<sup>111</sup> Number,

number be not considered the cause of essence. Aristotle's substitution of "the same kind of number" for "the same number" seems to be justified by the Pythagorean method to which he refers in *Metaphysics* 987 A 22-27 where he implies that they assign the number two as the essential cause to whatever is double "as if double and the dyad were the same thing." The result of such reasoning is that many things are identified with one number, a conclusion which they themselves accepted, he says.

<sup>109</sup> He cites a number of these which he implies were presented by the Pythagoreans themselves. There are seven vowels, seven strings in the scale, seven Pleiades, at the age of seven years the teeth are cast, and there were seven against Thebes. Aristotle answers that not all animals lose their teeth at seven years, that the number of champions was a result of the number of gates at Thebes, that we count seven stars in the Pleiades and twelve in the Bear but that others count more. They also say that there are three double letters ( $\Xi \Psi \Omega$ ) because these are concords of which there are three ([Alexander], *Metaph.*, 833, 4-5 says  $\xi$  was identified with the fourth,  $\psi$  with the fifth,  $\omega$  with the octave); to which Aristotle answers that there might be any number of double letters and, if they say that only these three are equivalent to two others because there are three parts of the mouth (i. e. palate, lips, and teeth) in each of which a single letter is added to sigma, the reason for the three is not the supposed fact that there are just three concords. Some others argue that the middle strings (the fourth and fifth) are the numbers 8 and 9 (the ratio of the fourth is 8:6, of the fifth 9:6) and that the epic verse having seventeen syllables, nine in the first half and eight in the second, is equal to the sum of these; they also say that the number of letters in the alphabet is equal to the number of tones on the flute (i. e. 24) and that this is the number of the whole universe.

<sup>110</sup> A reference to such interpreters as Theagenes (cf. Diels, *Vorsokratiker*, § 72, 2), Pherecydes (*ibid.*, § 71 B 5), Metrodorus of Lampsacus (*ibid.*, § 48, 2, 3, 4).

<sup>111</sup> The Pythagoreans placed the One and the Good in the same column of



then, cannot be a principle since it does not fulfil the function of any one of the four causes.

The concept *φύσις* includes for Aristotle all four of these phases of causality; and much of his argument against previous explanations of physical processes is based upon the contention that one or another of these causes had been neglected or their interconnection misunderstood. As he contends that the Presocratics for the most part recognized only the material cause, in his discussion of the meaning of *φύσις* he naturally argues that by that term they meant matter alone, "that which in each thing is primarily present without form in itself," and this, he adds, they considered the essence of everything which exists naturally.<sup>112</sup> An argument in support of this view he quotes from Antiphon<sup>113</sup> who claimed that as a bed if buried and rotting would, if it could grow, send up a shoot of wood thus proving that it was naturally wood and only artificially a bed so of gold

opposites, and Aristotle implies that this means only that they are analogically the same. In *Nicomachean Ethics* 1096 B 5-7 he says that more reasonable than the Platonic notion of a separate Idea of Good is the Pythagorean doctrine which places the One in the column of goods. For his polemical purpose there he interprets the Pythagorean table as meaning that each of the contraries is a manifestation of good in one column and evil in the other, a doctrine which approaches his own that the good is found manifested in all the categories so that there is no single good comprehending them all (*Eth. Nic.* 1096 A 19-29). Speusippus, Aristotle says, followed the Pythagoreans in this doctrine; to Speusippus and the Pythagoreans he also ascribes the notion that the best does not occur as an original principle but is the result of development (*Metaphysics* 1072 B 20-1073 A 3; cf. 1075 A 36-37 and 1091 A 29-B 3 [Speusippus]), a notion derived he says from the fact that the good of plants and animals seems so to be developed. Against this he argues that the seed comes from what is perfect and that not the seed but the actual man is prior (cf. *Metaphysics* 1092 A 9-17). Ross (*Commentary on Metaphysics*, II, p. 381) says that the Pythagorean ascription of the higher entities and qualities to the higher numbers shows a tendency toward the theory here attributed to that school. The doctrine is mentioned only in connection with Speusippus, however, and it is possible that Aristotle attributes it to the Pythagoreans on the authority of Speusippus alone who made a point of finding his own theories in Pythagorean documents (cf. *Theolog. Arithmet.*, p. 61 [Ast] = Speusippus, *fragment* 4 [Lang] and E. Frank, *Plato und die sogenannten Pythagoreer*, pp. 242-3).

<sup>112</sup> *Physics* 193 A 9-28.

<sup>113</sup> He was a contemporary of Socrates; cf. Xenophon, *Memorabilia*, I, 6.

or bones or wood, if they stand in a similar relationship to some other body, that other body which persists in these continuous changes is the nature. This reasoning Aristotle then imputes to all who posited one of the four elements or all of them as the nature of existing things. Here it should be noted that he implies that the various material principles were themselves called *φύσις* and that because these principles were themselves eternal while everything else was subject to generation and destruction he substitutes for *φύσις* his own concept *οὐσία*, saying that the Presocratics made these principles the universal substance of which all other things were modifications, states, and dispositions. To this argument Aristotle responds that *φύσις* is in another sense the form inasmuch as what is only potentially flesh or bone has not attained its own nature until it has the form by which one defines its essence and that the form rather than the matter is *φύσις*, since a thing is more correctly said to be such when it exists actually than when it exists potentially. In natural objects, moreover, the form produces the form; and in nature regarded as process the progression toward which the development tends is the form. That which is composed of *φύσις* in these two senses, matter and form, however, is not itself nature but a natural object.<sup>114</sup> This Aristotelian doctrine according to

<sup>114</sup> *Physics* 193 A 28-B 18. Cf. *Metaphysics* 1014 B 16-1015 A 19 where Aristotle gives the following meanings for *φύσις*: 1) *γένεσις*, 2) the primary inherent source of growth (i. e. the seed), 3) the primary efficient cause of motion in natural objects, 4) the unshaped and unchanging matter of natural objects, 5) the essence of natural objects, 6) essence in general. Things composed of form and matter exist *by nature*; and the fifth sense is the primary and strict sense of *φύσις* (i. e. formal cause), for matter is so called only because it is capable of receiving form and processes of generation and growth because they proceed from it, while the third sense (the efficient cause) is the form inherent either actually or potentially.

Here, too, he says that some have called the elements of natural objects their nature (*φύσις*), fire, earth, air, water, or some such body, or all of the four. This list is meant to designate all the Presocratics including Empedocles (cf. *οἱ δὲ πάντα ταῦτα*). The meaning of *φύσις* as essence of natural objects is exemplified by the doctrine of those who speak of *φύσις* as *τὴν πρώτην σύνθεσιν* which must refer to Aristotle's own conception of the physical world as conjunction of matter and form (cf. *De Part. Animal.* 645 A 30-36, *Physics* 195 A 19-21 = *Metaphysics* 1013 B 21-23, *De Generatione* 317 A 23-27 where this analysis of *οὐσία* is used against the pluralists' notion that genesis is mere



which either the material or the formal cause may be called the φύσις of an object shows how Aristotle came to say that the Presocratics identified φύσις with their various material constituents, for, once he had decided that they recognized only the material cause and identified all the world with it, his own terminology forced him to assert that φύσις in all of its senses was for them just the material element or elements which they severally adopted and in which his own distinction of matter, form, and

combination). Aristotle then adds as another example of φύσις used in the sense of essence a misquotation of Empedocles, *fragment* 8 (φύσις οὐδενός ἐστιν ἐόντων ἀλλὰ μόνον μίξις τε διάλλαξις τε μιγέντων ἐστί, φύσις δ' ἐπὶ τοῖς ὀνομάζεται ἀνθρώποισιν is written instead of φύσις οὐδενός ἐστιν ἀπάντων θνητῶν, οὐδέ τις οὐλομένου θανάτοιο τελευτή, ἀλλὰ μόνον μίξις τε διάλλαξις τε μιγέντων ἐστί, φύσις δ' ἐπὶ τοῖς ὀνομάζεται ἀνθρώποισιν). Here Aristotle takes φύσις = οὐσία and supposes that Empedocles meant to deny essence and substitute for it combination and segregation. The quotation, then, is merely an example of φύσις = οὐσία and is not meant to imply that Empedocles believed οὐσία = πρώτη σύνθεσις. (In *De Generatione* 333 B 9-16 Aristotle also takes φύσις in this passage to mean οὐσία [cf. page 234, note 77] but in 314 B 7-9 he interprets it as meaning "generation" or "becoming" [cf. page 109, note 446].)

As to the real meaning of the fragment Burnet (*E. G. P.*<sup>3</sup>, p. 205, n. 4) follows Lovejoy (*Philosophical Rev.*, XVIII, pp. 371 ff.) in interpreting φύσις as "substance." (Lovejoy translates "permanent nature.") It seems that this interpretation arose because it was felt incongruous for Empedocles to say "there is no becoming (so φύσις is interpreted by Plutarch, *adv. Colot.* 1112 A; *De Melisso* 975 B 6 ff. and most later scholars [cf. Beardslee, *The Use of φύσις in Fifth Century Greek Literature*, p. 11, n. 4]) and no death of mortal things." Therefore, φύσις is translated as "permanent nature" and θανάτοιο τελευτή as "cessation of death" rather than "death" or "end in death." Now the fact that Aristotle interprets φύσις as οὐσία, when seeking in previous philosophy an indication of his special doctrine, is no evidence for the meaning Empedocles gave the word. Further, there is no difficulty in the phrase, "there is no death of mortal things," if "death" mean "final destruction" as it evidently does; in fact, the same notion is stated unambiguously in a fragment of Euripides (*fragment* 836, Nauck) preserved in an Aristotelian fragment (*fragment* 20): χωρεῖ δ' ὀπίσω τὰ μὲν ἐκ γαλας φύντ' ἐς γαῖαν τὰ δ' ἀπ' αἰθερίου βλάστοντα γονῆς εἰς οὐράνιον πόλον ἦλθε πάλιν, θνήσκει δ' οὐδὲν τῶν γιγνομένων, διακρινόμενον δ' ἄλλο πρὸς ἄλλω μορφὴν ἰδίαν ἀπέδειξεν. Not only does this establish the possibility of the traditional interpretation of the Empedoclean fragment, but also the thought is obviously influenced by Empedocles and appears to be merely a versification of his doctrine. The invariable meaning of the Homeric periphrasis θανάτοιο τέλος makes it practically impossible to take θανάτοιο τελευτή in any other sense; moreover, Burnet, seeing that if φύσις means "substance"

source of motion was obscured.<sup>115</sup> The physicist or student of nature must consider nature in both its aspects, he says, the formal and the material, although one who looked to the ancients for guidance in this matter would think that only the material cause is the object of physical investigation, for of them only Democritus and Empedocles touched on the form or essence and they did so only to a slight extent.<sup>116</sup> It is true that the physicist must also consider the final and efficient causes; and, as will be seen, Aristotle frequently criticizes particular explanations of his predecessors on the ground that the peculiar characteristics of one of these two causes has been neglected, but in the end both final and efficient causality reduce to specific form, and the material cause itself is relative to the formal cause.<sup>117</sup> It is the formal cause as efficient which creates the unity of form and matter in the effect; the cause, then, of that unity is the form, but when Aristotle objects that no one, not even the Platonists, has explained why a substance is a unity he stresses the efficient phase of the form, because that was not explicitly set forth by his predecessors, and slurs the fact that in his own system this efficiency is nothing more than the agent-

or "permanent nature" ἐπὶ τοῖς cannot refer to μίξις τε διάλλαξις τε, refers it to θνητῶν, the temporary compounds, although no one before Anaxagoras could have called such things as flesh, bone, etc. φύσις in that sense. ἐπὶ τοῖς can refer only to the process of mixture and dissolution (so Aristotle construed it also, cf. page 234, note 77) and must represent what Empedocles considers a false but common usage. That usage which he continually criticizes (e. g. *fragments* 9, 11, 12) is the substitution of "genesis" for what is really only concretion and segregation.

<sup>115</sup> Cf. Beardslee, *op. cit.*, pp. 103-104. On the meaning of Plato's *Laws* 891-2 which Burnet (*E. G. P.*<sup>3</sup>, pp. 363-4) believes to support his thesis that φύσις was the Presocratic term for the "stuff" of which the universe is constituted see Beardslee, *ibid.*, pp. 100-101 and pp. 93-95 on the question of whether φύσις ever meant "element."

<sup>116</sup> *Physics* 194 A 12-27; cf. page 227, note 44 *supra*.

<sup>117</sup> *Physics* 194 A 27-B 9; cf. *Physics* 198 A 15-35. The real cause is the form (cf. *Physics* 195 B 21-25) and the form in the agent becomes an efficient cause by the simultaneous actualization of itself as agent and of the form in the patient as effect (cf. *Physics* 195 B 16-21 and with regard to motion *Physics* 202 A 7-21). See L. Robin, "Sur la conception aristotélicienne de la causalité," *Archiv für Geschichte der Philosophie*, XXIII (1910), pp. 204-207.



patient relationship since the actuality of formal cause in agent and patient as such is simultaneous.<sup>118</sup>

Apart from Aristotle's four causes there is chance which was commonly regarded as a cause and so requires his attention, particularly since he finds in it a doctrine incompatible with his teleological theory of causality. The ancients who were concerned with the causes of generation and destruction never considered chance and so seem to have thought that chance is not a cause of anything, while some definitely assert that there is a specific cause for everything which is commonly called the re-

<sup>118</sup> Cf. *Metaphysics* 1075 B 34-37 (cf. 1075 B 19-20). So (*Metaphysics* 1045 A 20-B 12) in definitions the unity is due to the fact that the proximate matter and the form are identical, the one as potency the other as actuality; but the cause of the alteration from potency to actuality Aristotle cannot explain except by appealing to efficient causality which in the end turns out to be formal, itself not completely actualized as efficient until brought to bear upon potential form in the patient. (Cf. page 235, note 82 *supra*.) On the basis of this explanation, however, he criticizes those who sought an explanation of the unity of definition in such formulae as connection or communion or participation of things which he thinks never exist separately. (The formula of participation refers to Plato; of "communion" Aristotle gives an example from Lycophron the Sophist, "knowledge is communion of knowing and the soul"; an example of "conjunctive definition" is "life is the conjunction of soul and body.") A true definition must give the cause which makes a certain matter the object or event that it is; this cause is the form (cf. Robin, *op. cit.*, pp. 184-193) which specifies the genus that is its material. On this basis he argues (*Topics* 127 A 3-19) that wind cannot be "air in motion" (cf. page 129 *supra*) for the genus, i. e. the material, remains the same whether in motion or not. Consequently wind is not air at all. (This argument overlooks the fact that the genus may include opposite species. Cf. Waitz on *Topics* 127 A 6 and 125 B 37; it places all the stress upon the material cause.) What Aristotle really intends to say is that "air" is not the *proper* genus; this is clear from his admission that this particular definition may be right but the similar ones, "snow is frozen water" (cf. Aëtius, III, 4, 1 and 2; Hippolytus, *Refut.*, I, 7, 7; Sextus, *Pyrrhon. Hypotyp.*, I, 33) and "mud is earth mixed with water" are wrong because the genus, i. e. the material cause, is wrong in both. Similarly Empedocles' definition of wine as "water decayed in the wood" (cf. Empedocles, *fragment* 81) is wrong because the material substrate of wine is not water. On the other hand he attacks certain definitions which give a differentia that does not inhere in the substrate, for here the attribute is obviously not the form of the particular matter to be defined (*Topics* 145 A 37-B 20). Sleep is not

sult of chance.<sup>119</sup> Nevertheless, Aristotle says, there is a difference between so-called chance occurrences and others; and, since the Presocratics obviously did not believe chance to be analogous to such principles as "Love," "Strife," "Mind," or fire, they should have attempted to explain what it is, especially since some of them make use of it as Empedocles seems to do when he says that the separated air does not always rise to the topmost region but "now in its course comes together in one way and now in another" <sup>120</sup> and that most of the parts of animals are due to chance.<sup>121</sup> Others, too, say that the whirl and movement which produced this universe and all the worlds were fortuitous;<sup>122</sup> and this Aristotle finds the more absurd because these same thinkers assert that plants and animals are not results of chance but of nature, mind, or some such cause, for from a given seed a definite plant or animal must result. The most divine of visible things, then, the heaven and the heavenly bodies, he argues, ought not to have an inferior cause, especially since experience shows no fortuitous event in the heavens and many chance occurrences among plants and animals.<sup>123</sup> This

"the debility of sensation," perplexity is not "equivalence of opposite reasons," and pain is not "forceful separation of connate parts" (cf. Plato's *Timaeus* 64 D-E), for these differentiae are not forms inhering in the substrates with which they are in these definitions connected. For the same reason health cannot be "the symmetry of hot and cold" (evidently a reference to the theory of Alcmaeon, cf. Aëtius, V, 30, 1; Plato, *Timaeus* 82 A-B). These, then, are not definitions at all but rather statements of the efficient cause.

<sup>119</sup> *Physics* 195 B 36-196 B 7. Those who denied that chance is the cause of anything are referred to again in 196 A 14; according to Eudemus they were Democritus and the Atomists (cf. Simplicius, *Phys.*, 330, 15-20).

<sup>120</sup> *Fragment* 53. Aristotle may have interpreted *συνέκυψε* as "it happens," but Diels' rendering, "stieß bald so . . . zusammen (*mit den übrigen Elementen*)" is certainly right.

<sup>121</sup> Cf. Simplicius, *Phys.*, 371, 33-372, 9. On chance in Empedocles' system see pages 189, note 187 and 190, note 193 *supra*.

<sup>122</sup> These Simplicius, *Phys.*, 331, 16 ff. identifies as Atomists.

<sup>123</sup> The same refutation of the same "inconsistent" doctrine appears in *De Part. Animal.* 641 B 12-26 where Aristotle argues that Nature makes all things *ἐν ἐκὰς τοῦ* and that definite arrangement is a sign of process toward a goal as final cause. For proportion and order as defining characteristics of "Nature" and the use of this concept in the refutation of a supposed precosmical state see pages 178 and 193 *supra*.



notion of chance as the cause of the world-building movement seems to refer to the Atomists but is obviously inconsistent with the evidence that they insisted upon the universality of causal relationship. Aristotle's next statement, however, that some thought chance to be cause but cause which is unfathomable by human reason<sup>124</sup> offers an explanation of the apparent inconsistency, for this represents the doctrine of Anaxagoras and Democritus<sup>125</sup> to the effect that chance is but a subjective term for causes too complicated or too remote to be clearly explained by human knowledge and does not at all relax the stringency of the Atomists' rule that everything has a definite, if not a definable, cause.<sup>126</sup> Just as Aristotle thought that "Necessity," which was no more than the Atomists' way of expressing the infrangible universality of the law of cause and effect, was an evasion of the philosopher's duty of indicating the cause, so he supposes that "Chance," by which they meant no more than a causal connection unascertained or unascertainable by reason of human limitations, was intended to represent a particular type of causality. The implications of these terms, however, even when correctly interpreted, are at variance with Aristotle's fundamental concept of cause, for to the Atomists as well as the other Presocratics the causal relationship was strictly mechanical and the notion that certain effects necessarily follow from conditions which have arisen without regard to the results seemed to them to controvert once and for all the popular opinion that there is in natural events an element of purpose. Consequently, when it is said that the whirl is the result of chance, the meaning is not alone that this particular effect arose from mechanical causes so varied and remote that no exact description of them can be given<sup>127</sup> but also that the world itself is in

<sup>124</sup> O. Hamelin (*Aristote Physique*, II, pp. 111-112) thinks this refers only to people who gave cult honors to Τύχη; but ἀδελος ἀνθρωπίνη διανοία here compared with 197 A 9-11: ὁθεν καὶ ἡ τύχη τοῦ ἀόριστου εἶναι δοκεῖ καὶ ἀδελος ἀνθρώπῳ καὶ ἔστιν ὡς οὐδὲν ἀπὸ τύχης δόξειεν ἂν γίνεσθαι points quite certainly to the Atomists.

<sup>125</sup> Cf. Aëtius, I, 29, 7; Theodoretus, VI, 15; Simplicius, *Phys.*, 329, 25: δὲ ἀναιρεῖ τὴν τύχην διὰ τὸ ὥρισθαι πάντων τὰ αἷτια τὴν δὲ τύχην ἀόριστον εἶναι.

<sup>126</sup> See page 179, note 146 *supra*.

<sup>127</sup> Democritus may possibly have intended by this statement a polemic against

no way the work of design, that the result is not the purpose of the antecedent conditions but the necessary outcome of events, themselves determined by no end to be attained. This is also the meaning of chance in the cosmology and physiology of Empedocles; but to the Socratic teleologists for whom the essential nature of an object was φύσις in the strict sense any explanation which neglected the final cause seemed to deny causality altogether.<sup>128</sup>

Aristotle himself attempts to retain the notion of chance and automatic events by distinguishing between usual and exceptional occurrences, among the latter of which those that produce a result which might have been the final cause of a natural process are said to bring about the result by chance. Chance, then, is a cause *per accidens*; and, since the possible accidents of a subject are unlimited, some justification is found for the statement that chance, falling under the category of the indefinite, is for man inscrutable and contrary to reason.<sup>129</sup> Such an analysis does not attribute any event to mere contingency, for every chance result has a determinate cause, its fortuitous character being due solely to the fact that the chain of events is unforeseen,<sup>130</sup> so that in so far as the indeterminateness of the chance event is only subjective Aristotle's doctrine is not at odds with that of Democritus; but in limiting chance and automatic<sup>131</sup>

the circumstantial accounts given by some of his predecessors as well as against the hint of teleology which he found in the νοῦς of Anaxagoras.

<sup>128</sup> Cf. Heidel, *Proceedings of the American Academy of Arts and Sciences*, XLV (1910), pp. 108-109. Plato, *Laws* 889 B-D identifies the φύσις of the Presocratics with τύχη on the ground that in their explanations of natural processes they neglect to assign a purposive cause.

<sup>129</sup> *Physics* 196 B 10-197 A 21.

<sup>130</sup> Even the automatism by which, for example, health is produced in a sick body without the intervention of a physician and lower forms of life are "spontaneously" generated is due to the presence of the definite moving cause within the matter itself (cf. *Metaphysics* 1032 A 27-32) which by its peculiar constitution is capable of setting up this motion (cf. *Metaphysics* 1034 A 9-21, 1034 B 4-7).

<sup>131</sup> "Chance" strictly applies only to those events the result of which might be due to conscious purpose and so is restricted to beings endowed with the faculty of choice, while "the automatic" is the wider term and includes the results which might have come about through the ordinary (teleological) processes of nature (*Physics* 197 A 36-B 37).

events to those processes which result in ends compatible with the purposive choice of man or the unconscious purpose of nature Aristotle is able to argue that the universe cannot be the result of chance which by definition is a cause only *per accidens*, for that which exists accidentally presupposes the existence of the self-sufficient. Chance, then, as accidental cause must be posterior to mind and nature which are causes in themselves;<sup>132</sup> and in this way the Atomists' account of the cause of the universe is shown to be insufficient because it neglects the final cause which Aristotle thinks is required by its own terminology.<sup>133</sup>

Nature viewed as cause and as primary cause is for Aristotle the end toward which natural processes and objects strive and so the formal cause. The cause to which, he says, all his predecessors referred all natural occurrences is necessity,<sup>134</sup> in that they say that the origin and characteristics of all generated things are determined mechanically by the characteristics of the elements which constitute them. When he adds that, if they mentioned any other cause, such as "Love" and "Strife" or "Mind," they straightway abandoned it with a word, he means to repeat that the "Necessity" which they made the sole type of causation was the material characteristics of their elements.<sup>135</sup>

<sup>132</sup> *Physics* 198 A 5-13. Cf. the abbreviated résumé in *Metaphysics* 1065 A 27-B 4.

<sup>133</sup> See page 171, note 117.

<sup>134</sup> *Physics* 198 B 10-199 A 8.

<sup>135</sup> In *De Part. Animal.* 640 B 4-17 "the ancient investigators of nature" are criticized for restricting their attention to the material principle. They were interested in its nature and in the process of the generation of the universe from it, making the moving cause "Love" and "Strife," "Mind," or "the automatic" (by the last all those who made motion a specific characteristic of matter are meant) and explaining the resulting cosmos as due to the "necessary" character of their material principle, the heat of fire, the coldness of earth, etc. In the same way (i.e. by the mechanical necessity of material causation) they explained the genesis of the organic world, e.g. the stomach and body cavities resulted from the action of the water flowing in the body, the nostrils were broken open by the outward passage of the air (these explanations probably come from Empedocles; cf. Michael Ephesius, *De Part. Animal.*, 5, 19-25 and *De Part. Animal.* 640 A 19-22; Hippocrates, *περὶ ἀρχαῆς ἰητρικῆς*, § 20 [Littré, I, 620]); since they considered air and water to be the material of which bodies consist, this amounts to reducing the cause of organic bodies to the characteristics of matter.

Such a doctrine might explain natural processes as moving to no particular end and not being determined by the tendency toward the better condition but as occurring in a simply mechanical fashion with accidental results that only *seem* to have been the purpose of the development. So rain falls because the rising moisture must cool and, cooled, must fall as water; the nourishment of grain is an accidental result, not the final cause, of this. According to such a theory those beings would survive, all the parts of which had chanced to grow so as to be serviceable for the survival of the whole, and all others would perish like the "human-headed oxen" of Empedocles.<sup>136</sup> To this Aristotle objects that natural objects have always or usually a constant character while the results of chance have not; these formations show by their constant recurrence that they are not the result of chance, and the only alternative is that they exist "for a purpose." From this he argues that, since such thinkers as Empedocles admit that these formations are natural, they would have also to grant a final cause in natural objects and processes. Aristotle's refutation of Empedocles' theory of adaptation seems to depend upon the permanence of types in organic reproduction; but this apparently overlooks the fact that Empedocles seems to have assumed that each animal reproduces its own kind without variation, the great variety of forms being due to mechanical combination. Of these combinations the greater number, being unable to survive in their environment, perished without reproducing.<sup>137</sup> Such a theory might still be faced with the problem of explaining why types are permanent in reproduction<sup>138</sup> and how the adaptations are inherited in the beginning; but Aristotle does not touch the real difficulties of the evolutionary theory. His attempt to prove that such theories must recognize organic parts to be determined by final cause,

<sup>136</sup> Cf. Empedocles, *fragment* 61 and Simplicius, *Phys.*, 372, 2-8.

<sup>137</sup> Cf. Empedocles, *fragment* 61, line 4: *στειροὺς ἢ σκημένα γυλοῖς* and cf. Lucretius, V, 848, 856.

<sup>138</sup> In *De Generatione* 333 B 3-9 Aristotle complains that Empedocles gives no cause for the uniformity of generation and there distinguishes between the natural and fortuitous by means of the difference between what is "for the most part" and what is only occasionally. He is there emphasizing the necessity of formal cause (cf. page 233 *supra*).



however, turns on an ambiguous use of the term fortuitous. It is quite clear that the "chance combinations" of which Empedocles spoke were not by him considered to be contrary to nature, and Aristotle's distinction between the usual and the exceptional discovers no real difference between the natural and fortuitous; even if the original variation were fortuitous in the extreme sense of having *no* cause—a sense which no Presocratic ever attached to the word—it might well be preserved by the ordinary course of cause and effect. Moreover, the disjunction that the products of nature must be either fortuitous or purposeful is the result of Aristotle's failure to recognize mechanical causation as such and would certainly have seemed unintelligible to the Presocratics; but, because to Aristotle all causation must be in the end related to the form as final cause and this the Presocratics did not recognize, he reduces their mechanism to the equivalent of his own material cause and so identifies their terms, "necessity" and "chance," under the influence of his own doctrine which traces necessity, as "resistance," and chance, as "indeterminateness," to the material.<sup>139</sup> The opposition of chance and nature derives from the contrariety, matter-form, and begs the question by identifying the natural with the formal and purposive in order to interpret the fortuitous as the completely indeterminate. Aristotle himself admits that the fortuitous birth of monsters is "contrary to nature" not in the sense that it does not proceed from natural causes but only because the form fails to master the matter completely;<sup>140</sup> the whole doctrine rests upon a circular argument, for when the variations are frequent they can no longer be called monsters. Consequently, the various forms of the Empedoclean monsters would have to be called natural as proceeding from the same order of cause and effect which produced the variations that managed to survive; and, if on Aristotle's narrower concept of nature they were unnatural because the matter had not been fully shaped by a form as yet indeterminable, they could not be called fortuitous either for they did not fall within the scope of purposive action.

<sup>139</sup> Cf. Heidegger, *The Necessary and the Contingent in the Aristotelian System*, pp. 27-28, 30-32.

<sup>140</sup> *Physics* 197 B 32-37, *De Gen. Animal.* 770 B 9-27.

The direct proof that nature is the final cause as form rests upon the argument that in all processes which result in a final term the successive stages are performed for the sake of that term.<sup>141</sup> Natural and artificial processes both move continuously in a definite order to a term at which they rest, and this implies that the action of both is teleological.<sup>142</sup> Further, from the fact that art either completes nature or imitates it<sup>143</sup> Aristotle concludes that one may deduce from the teleological character of artificial objects that of natural creations, inasmuch as there is the same relationship of antecedents and consequents in both. The analogy is strengthened by the fact that certain animals without art or deliberation move naturally toward ends such as art might produce; and the continuous scale of species through animals and plants to inanimate nature, in which man's art, the instinct of animals, and the specialization of vegetable organs all work toward specific ends, supports the view that all that arises and exists naturally is related to a final cause.<sup>144</sup> This final cause, however, is nature in the special sense of form, for nature designates both matter and form and the latter is the term for the sake of which other things exist. The "mistakes" of nature which might seem to be evidence against nature as final cause are by the aid of this analogy turned into corroborative testimony, for monstrosities, like mistakes in an artificial process, are explained as frustrated attempts to attain the end.<sup>145</sup> If the ox-like monsters of Empedocles ever existed, their inability to reach a term of development must have been due to impairment of the principle which produced them. That is, Aristotle insists that such creatures must have been frustrations of development just as natural monsters are due to the weakness of the seed which is thereby incapable of completely imposing the form on its material. Such an interpretation requires that the monsters be sprung from a seed or principle which car-

<sup>141</sup> *Physics* 199 A 8-32.

<sup>142</sup> Cf. *De Part. Animal.* 639 B 14-21; *De Gen. Animal.* 734 A 25-32, 767 A 16-17, *Politics* 1333 A 21-24.

<sup>143</sup> Cf. *Meteorology* 381 A 10-11, 381 B 3-7.

<sup>144</sup> Cf. *Hist. Animal.* 588 A 25 ff. and Hamelin, *Aristote Physique* II, pp. 155-156.

<sup>145</sup> *Physics* 199 A 33-B 18.

ries the formal cause; Aristotle therefore argues that the animals cannot have arisen forthwith but must have been developed from seed.<sup>146</sup> The "undifferentiated form" which Empedocles said existed first<sup>147</sup> Aristotle says is really the seed; by this he probably did not mean that Empedocles himself intended to designate seed by the "whole-natured forms,"<sup>148</sup> but in order to find in Empedocles' account some state previous to the monsters which might serve as the "impaired principle" to explain their variations from the normal development he implies that these undifferentiated forms preceded the "ox-like creatures," whereas in the original the two notions belong to separate periods of the world's history, the latter representing the formation of animals during the advance of "Love" and the former the process resulting from the encroachment of "Strife" upon the *Sphere*.<sup>149</sup> Once having read into the description of Empedocles something analogous to the seed of monstrosities, he presents the objection that the production from it of such variations as Empedocles describes requires one to suppose that any chance formation can develop from a given seed, a supposition which annihilates the concept of nature. Those things are natural which moving continuously from some

<sup>146</sup> This seems to contradict the statement (*Metaphysics* 1072 B 35-1073 A 1), τὸ πρῶτον οὐ σπέρμα ἐστίν, ἀλλὰ τὸ τέλειον cf. *Metaphysics* 1092 A 16-17; but in the generation of the particular individual the seed is prior (cf. *Metaphysics* 1050 A 4-6, *De Part. Animal.* 646 A 24-B 2).

<sup>147</sup> He writes οὐλοφύες μὲν πρῶτα from Empedocles, *fragment* 62: οὐλοφύεις μὲν πρῶτα τύποι χθονὸς ἐξανέτελλον.

<sup>148</sup> Simplicius (*Phys.*, 382, 4-5) thinks this is Aristotle's meaning and Hamelin (*op. cit.*, p. 157) concurs; Millerd (*op. cit.*, p. 70) corrects Simplicius but finds here nothing more than a "comparison of the whole-natured forms to seed."

<sup>149</sup> Millerd, *op. cit.*, pp. 49, 56-57, 70; Burnet, *E. G. P.*, pp. 242-243. In *Physics* 199 B 9-13 Aristotle adds a further objection. In plant life the expression of purpose exists but in a less accurately distinguishable form. One would consequently expect to find more monstrosities among plants than animals; but Empedocles has not spoken of vegetable monsters analogous to his "human-headed oxen" which, however, ought to have existed as well as they. We must accept Aristotle's implication that nothing definite was said of vegetable monstrosities by Empedocles; but that he meant his description of the formation of animals to hold in its broad outline for plants as well is clear from *fragment* 20 (cf. Aëtius, V, 19, 5).

inherent principle arrive at a term of development; this term is different for the processes proceeding from different principles but, in so far as the process is not impeded, it is constant and determined for each.<sup>150</sup> This refutation is entirely beside the point, for, however absurd Empedocles' account of the original organic forms may be, it does not represent them as "variations" in the development of a specific germ plasm; Aristotle has refuted a theory which he himself first constructed and then represented as the necessary meaning of Empedocles, for, having tried to prove that the original monstrous forms as "variations" must have arisen from seeds, he then by a violent misinterpretation found in Empedocles' account something which he could treat as analogous to such seeds and demonstrated that the derivation from them of monstrosities of "crossed types" destroys the fundamental concept of nature.

The chance occurrences which entail actions that might have been purposive and ends that might have been final are not capable of explaining natural processes, for the former are essentially accidental and, if they occur always or usually as the latter do, can no longer be considered fortuitous as being *per accidens*.<sup>151</sup> The absence of a deliberating moving cause is no reason for denying the existence of finality;<sup>152</sup> even art, which is a final cause exterior to the artificial product, does not deliberate,<sup>153</sup> and nature is, as it were, art inherent in the products of its activity. The Presocratic concept which Aristotle calls "Chance" is, as has been shown, pure mechanical causation and the "Necessity" of which the mechanists spoke is the ineluctable determination of the consequents by their material antecedents acting in the only manner allowed them by their specific characteristics. But this type of necessity is incompatible with the doctrine of a final cause; and Aristotle insists that the

<sup>150</sup> Cf. *De Part. Animal.* 641 B 23-30. For Aristotle all deviations from the "normal" development of the seed must be due to some impediment which then must be traced to the matter which the seed informs. Such deviations, however, cannot extend so far as a "crossing of types."

<sup>151</sup> *Physics* 199 B 18-26.

<sup>152</sup> *Physics* 199 B 26-33.

<sup>153</sup> Deliberation is a sign of insufficiency on the part of the technician; quâ artist he needs no deliberation, cf. *Nic. Eth.* 1112 A 34-B 9.



consequent determines the antecedents as the end the means. The purpose, then, is to be found in the concept, i. e. the form; the necessity which resides in the matter is hypothetical, being relative to the end which the matter has to serve.<sup>154</sup> The Presocratics, he suggests, in referring all their explanations to necessity were misled by their failure to distinguish the various meanings of "necessary."<sup>155</sup> Eternal existences are absolutely necessary, he admits, because their principle is Being as such; but for natural objects in the sphere of Becoming the principle is rather "that which is to be."<sup>156</sup> Consequently it is not possible to refer to the eternal a demonstration concerning such objects so as to deduce the consequent from the antecedent. The nature of the material and the order of the various steps in the process are determined by the end to be attained in natural just as in artificial productions. The mechanical causes by which Democritus sought to explain everything Aristotle admits may function in natural processes but only as subordinate to a pur-

<sup>154</sup> *Physics* 199 B 34-200 A 15. Aristotle is, however, forced to recognize another kind of necessity which is in matter as the "resistance" to form. It is this resistance that explains monsters; and many things in nature are the result of both kinds of necessity (cf. *Post. Anal.* 94 B 27-95 A 3), while in some cases only the absolute necessity of mechanism is at work (*De Part. Animal.* 677 A 15-19, *De Gen. Animal.* 743 B 16-17, 778 A 29-B 19). Such a characteristic is incompatible with the concept of matter as pure potentiality; yet, if one has to admit that potentiality is not always completely actualized, a positive force of opposition to the formal cause must be attributed to the material (cf. Heidel, *op. cit.*, pp. 30-32).

<sup>155</sup> *De Part. Animal.* 639 B 21-640 A 9.

<sup>156</sup> Cf. *De Generatione* 335 A 32-B 7, 337 B 1-338 B 19; cf. Heidel, *op. cit.*, pp. 32-34. This confusion, Aristotle says (*De Gen. Animal.* 742 B 17-35) is at the bottom of the assertion of Democritus who, in saying that the first principle of constant occurrences is just that "they always so occur," said that to ask for any other cause of them is to demand a principle for what is unlimited; the constant is unlimited, the cause is a principle, and there is no cause of the unlimited. Yet, says Aristotle, there is demonstration of many things which either always happen or exist eternally, for there is a cause for mathematical truths. Of first principles there is no demonstration; but in unchanging things the principle is just the essence, in things which are subject to generation there are a number of principles different in kind. On the real meaning of the "Necessity" to which Democritus finally referred all processes cf. page 179, note 146 *supra*.

pose;<sup>157</sup> teeth may grow and fall out in the way Democritus describes but these mechanical causes are causes only as efficient instruments and matter of that final cause which is "the better condition." Breath, for example, is a versatile mechanism of nature, but to reduce causality to such a mechanism is like saying that water is drawn from the dropsical patient because of the lancet and not because of the health which is the purpose of the lancing. The mistaken view of the relation of antecedent and consequent which resulted from the exclusive attention paid to mechanical causation contributed, Aristotle thought, to defeat the attempts of earlier physiologists to outline the order of development of the parts of the embryo,<sup>158</sup> for without the proper understanding of the final cause they could not know that what is the end is prior in reality, while what exists for the sake of the end being prior in generation must be divided into the origin of motion and that which serves the final cause as instrument. Since the origin of motion—or the part in which it resides—is primary in generation, however, it is difficult to see why the Presocratics who were interested only in the order of generation should have been hampered in this particular investigation by their neglect of the final cause; any mistake they might have made must have been rather due to their failure correctly to identify the part which initiates motion. Not the mechanists, but rather Aristotle is embarrassed in this matter and that because, while insisting that the end in some sort must be primary, he cannot entirely eliminate mechanical necessity which requires that what is temporally subsequent be determined by the antecedent.<sup>159</sup> This difficulty he surmounts by identifying the part that contains the efficient cause, and so is

<sup>157</sup> *De Gen. Animal.* 789 B 2-15.

<sup>158</sup> *De Gen. Animal.* 742 A 16-B 10. Alcmaeon seems to have thought that the head is articulated first, Democritus the navel, Empedocles the region of the heart (cf. Aëtius V, 17; Censorinus, *De Die Natali* VI; Diels, *Doxographi Graeci*, p. 190).

<sup>159</sup> The same thing may be what it is necessarily, i. e. determined by the antecedent events or material nature, and for a purpose. So, for example, even if thunder exists to frighten the souls in Tartarus as the Pythagoreans say, the noise is also a necessary result of the quenching of fire in the cloud (*Post. Anal.* 94 B 27-36).

temporally primary, with the end as its most important part. This identification of efficient and final cause enables him to treat a single physical part as temporally primary quâ efficient cause and simultaneous with the completion of development quâ final cause. This necessary subsumption of the means under the end makes it difficult to find among the organs one to which can be *exclusively* ascribed this double nature.<sup>160</sup>

The conception of development as hypothetically necessary requires Aristotle to disagree with the very basis of the Presocratics' scientific method by which they derived the nature of physical objects from the manner of their production.<sup>161</sup> The process is determined by the form which is the end, for generation is due to essence rather than essence to generation;<sup>162</sup> consequently the form cannot be explained as a consequence of accidents of process as Empedocles accounted for the articulations of the spine by fracture resulting from the twisting of an originally straight backbone.<sup>163</sup> Such an explanation, Aristotle says, overlooks the fact that the seed from which the animal develops must have had the form of the animal potentially and, as efficient cause, must have been prior not only logically but temporally also.<sup>164</sup> Scientific explanation must, therefore, proceed from the character of the phenomenon as given to the nature of the generating process determined by that end. So long as the ancients neglected the formal and final causes and confined themselves to the matter and efficiency without even clearly distinguishing these two, they naturally thought that an

<sup>160</sup> Cf. Heidel, *op. cit.*, pp. 24-25.

<sup>161</sup> *De Part. Animal.* 640 A 10-B 4.

<sup>162</sup> The phrase of Aristotle gains force because of the ambiguity of *ἐνεκα*. "Generation is *for the sake of* existence not existence *for the sake of* generation" implies a disjunction which the mechanists denied.

<sup>163</sup> Cf. page 250, note 135 *supra*.

<sup>164</sup> A characteristic attaching to the form of the animal must have been imposed upon the matter by the seed which carries the form. This implies not only that the matter of the body cannot induce a change in the form the seed carries (i. e. that acquired characters cannot be transmitted) but also that the form is absolutely immutable. In order to maintain this view, however, it is necessary to hold that all variations from an arbitrarily determined norm are due to the imperfect information of matter which follows from the "resistance" of the material to the seed.

object has its peculiar character because of the nature of its process of generation;<sup>165</sup> in short so long as the nature of the formal cause was unrecognized it was impossible to understand the purposiveness of nature. If the Presocratics did not distinguish the essence of an object from its material constituents, they could not suppose that the matter was determined by a cause other than itself.<sup>166</sup> Their explanations which rest entirely on the character of the material, however, fail to account for the specific differences of the various homogeneous and heterogeneous parts of natural bodies and could not succeed in so doing, Aristotle says, as is shown by the fact that in describing an artificial object, such as a bed, it is more important to define the form than the matter.<sup>167</sup> This form is not merely the outward shape and color of the object either; Aristotle thinks that Democritus meant to define man by his external appearance when he said that "it is clear to everyone what sort of thing man is,"<sup>168</sup> and he points out that the shape of the corpse is unaltered although the corpse is not a man in any real sense. The form of which Aristotle speaks must be closely related to *function* inasmuch as it is the final cause whereas the shape is an aspect of the material cause and so is determined by the function. The philosopher who gives as the cause of natural pro-

<sup>165</sup> *De Gen. Animal.* 778 B 1-10.

<sup>166</sup> Cf. *De Part. Animal.* 642 A 13-32 where Aristotle says that a full scientific account must give both the final cause and the hypothetical necessity, as, for example, that respiration exists for this purpose and that such and such things must exist in order that it may take place. The essential nature, which is more of a principle than the matter, was disregarded by earlier thinkers because they paid no attention to definition; and, consequently, they could not follow the method here prescribed. Empedocles did stumble on essence, as it were forced to it by the truth, when he said bone was not any one or any number of the elements but the proportion of their mixture and Democritus touched on the matter of definition in passing but did not see its relation to scientific procedure (cf. page 245, note 116 and on the recognition of the formula by Empedocles, page 233, note 75 *supra*).

<sup>167</sup> *De Part. Animal.* 640 B 4-641 A 17; cf. page 250, note 135 *supra*.

<sup>168</sup> Aristotle quotes the remark as follows: *παντὶ δῆλον εἶναι ὅλον τι τὴν μορφὴν ἐστὶν ὁ ἄνθρωπος*. Sextus, *adv. math.*, VII, 265 quotes *ἄνθρωπος ἐστὶν ὁ πάντες ἴδμεν*. The Epicurean definition (Sextus, *ibid.*, 267) *τοιουτονὶ μόρφωμα μετ' ἐμψυχίας* seems to be a correction of Democritus induced by the present criticism of Aristotle.



duction air or earth gives a poorer explanation than the carpenter who says the axe or gimlet is the cause of the shape produced in the material to which the instrument has been applied;<sup>169</sup> but both err in the same fashion, for it is always the essential nature of the product that determines the instrument and the process and that is, therefore, the real cause.<sup>170</sup>

The importance of the final cause as function is best illustrated in Aristotle's physiological passages; although he brought to bear all the results of his wide and often keen observation in his criticism of earlier explanations of organic processes, it is his constant complaint that the Presocratics missed the truth because they ignored the final cause. This is the cornerstone of his refutation of the previous treatments of respiration,<sup>171</sup> a process the purpose of which he considered to be the cooling of the excessive heat necessary for the higher forms of life and so restricted to animals with lungs, among which the intensity of the process varied, he thought, according to the amount of blood in

<sup>169</sup> The carpenter at least clearly distinguishes the efficient cause from the material. Similarly the Presocratics are preferred to the theory of the *Phaedo* because they come nearer to a recognition of efficient causation (*De Generatione* 335 B 24-29, cf. page 228, note 48 *supra*).

<sup>170</sup> This is the argument used against Anaxagoras' statement that man is the most intelligent of animals because he has hands. Since the hands are instruments, they are necessitated by the essence which is the final cause; hence the truth is that man has hands because he is most intelligent (*De Part. Animal.* 687 A 7-18). This is expressed here, as frequently, by Aristotle's metaphorical representation of "Nature" as the prudent economist who distributes to each being the things it can use. The economy of Nature consists in fitting the means to the end in the best way possible. Similarly Aristotle (*Politics* 1256 B 31-37) denies that wealth is unlimited as Solon said (*fragment* I, line 71 [Diehl]), for wealth is defined as a group of economic and social instruments. This, however, he admits is true only of "real wealth"; the so-called wealth which is the result of "money-making" as such is unlimited because it is not an instrument directed to an end that determines it.

<sup>171</sup> *Parva Naturalia* 470 B 6-9. To Plato's account of the "cause" of respiration (*Timaeus* 78 E-79 A) Aristotle objects that it shows an ignorance of the nature of the phenomena (Aristotle's criticism of the whole account in the *Timaeus* occurs in *Parva Naturalia* 472 B 6-473 A 14); but of the Presocratics he says (*Parva Naturalia* 471 B 23-29) that, had they sought out the purpose of respiration and then examined the organs in the light of this purpose, they would have quickly discovered the causes of the phenomenon.

the lungs.<sup>172</sup> The classification of forms of life required, he felt, 'a parallel gradation in the process instrumental to life which varied from the most perfected form of respiration to the simple refrigeration furnished by the environmental water or air; and this, rather than his observations, occasioned his vehement objection to the thesis that all animals breathe.<sup>173</sup> This thesis, he says, is implied in the words of Democritus and some others and expressly maintained by Anaxagoras and Diogenes<sup>174</sup> who offered an explanation of the respiration of fish.<sup>175</sup> The former, on the assumption that no void exists, said that, after the water is expelled through the gills, the fish inhale the air remaining in the mouth; Diogenes supposed that the expulsion of the water left a void whereby the fish extracted from the outside water the air mixed with it.<sup>176</sup> These explanations Aristotle meets by saying that they fail to explain exhalation, that fish have no windpipe and so would have to draw the air from the mouth directly into the stomach which no breathing animal does, and that a fish does not send up bubbles as do all animals that exhale under water. He also objects that, if fish could extract air from water, men could do so too and that these explanations fail to show why fish die in the air where they seem to suffocate.<sup>177</sup> These arguments are drawn from observation; but they do not refute the

<sup>172</sup> *Parva Naturalia* 470 B 12-27, 474 A 25-B 14, 477 A 11-25.

<sup>173</sup> Note that he offers, instead of examples of non-breathing animals, evidence that the amount of blood in the lungs varies in various pulmonate species. Since the amount of vital heat varies directly with the amount of blood, he supposes that this proves a varying need of respiration and concludes that animals without lungs need no respiration and so do not breathe (*Parva Naturalia* 470 B 9-27).

<sup>174</sup> *Parva Naturalia* 470 B 28-32. The Atomists thought the "soul-atoms" were replenished by inhalation (cf. *De Anima* 404 A 9-16). For Diogenes cf. 51 B 4, Diels; according to [Aristotle], *De Plantis* 816 B 26 Anaxagoras said that plants, too, have respiration.

<sup>175</sup> *Parva Naturalia* 470 B 31-471 B 19.

<sup>176</sup> It appears that Diogenes explained the mechanism of inhalation in general as the "drawing in" of external air by a void created in the body. Plants, since they have no hollow portion in which a void can be created, cannot breathe. Cf. Theophrastus, *De Sensibus*, 44 and 48.

<sup>177</sup> This objection was anticipated by Diogenes who said that they die from an excess of air; but Aristotle calls this explanation "silly" on the ground that no land animal can be choked by inhaling too much air.



general thesis. Aristotle's one direct proof that not all animals breathe consists in his example of insects which live after having been cut into many parts.<sup>178</sup> The theory of Democritus, Aristotle admits, makes respiration a function of life by explaining that it prevents the soul from being squeezed out of the body; but he objects that it does not represent this function as the final cause of the process.<sup>179</sup> According to the Atomists the soul consists of minute spherical atoms which are constantly in danger of being extruded from the body by reason of the pressure exerted by the environment; the air inhaled, however, contains a large number of these "soul" or "mind" atoms which enter the body and counteract the external pressure thus preventing the extrusion of the "soul" atoms within the body.<sup>180</sup> Hence life and death depend upon respiration, for when the outside pressure gets the upper hand and the body cannot by inhalation restore the equilibrium, death, which is just the expulsion of such atoms from the body, ensues. This leaves unexplained, Aristotle says, the fact that all must die either of age or violence and does not show whether the real cause of death is external or internal. Further, the theory says nothing of the original cause of respiration, although clearly this must be internal and not due to the force of the environment; and it makes this environment responsible for both the pressure and the counter-pressure, which is absurd. Assuming that some animals do not breathe he denies, too, that the theory gives the universal cause of death and then attacks the assumed function of respiration by remarking that breathing is more frequent and more violent when the body is hot than when it is cold, although a cold environment presumably compresses the body the more.<sup>181</sup>

<sup>178</sup> *Parva Naturalia* 471 B 19-23.

<sup>179</sup> *Parva Naturalia* 471 B 30-472 B 5.

<sup>180</sup> Cf. *De Anima* 404 A 10-15. The inhaled atoms serve two purposes. They replenish the soul within, for some "soul" atoms are constantly being lost, and they counteract the external pressure.

<sup>181</sup> This implies Aristotle's own theory of the hot and cold as primary qualities, whereas for the Atomists heat and cold were merely secondary manifestations of rarity and density (cf. Theophrastus, *De Sensibus*, 65: *μάλιστα γὰρ θερμαίνεσθαι τὸ πλείστον ἔχον κενόν*; cf. *ibid.*, 60). The fact that the spherical atoms were called "hot" caused Aristotle to emphasize this characteristic as an essential

If that is so, according to the Atomists there should be greater need of respiration in cold environments in order to counteract the increased pressure. Aristotle himself thinks that the necessity for rapid breathing after the breath has been held supports his contention that the purpose is refrigeration of the accumulated heat. From Empedocles Aristotle quotes a long description of the respiratory mechanism<sup>182</sup> which is compared to the action of air and water in the pipette. Empedocles supposed that veins partly filled with blood ended at the surface of the body in orifices too small to allow the blood to escape but large enough to allow air to enter and that an oscillatory motion of the blood in these veins now forced out the air in exhalation and again allowed it to enter in inhalation. Paramount in this theory is that respiration occurs through pores distributed over the whole extent of the body; but Aristotle mistook the word *ῥινῶν* for the genitive of *ῥίς* (nostril) rather than of *ῥινός* (skin) and consequently upbraids Empedocles for falsely confining respiration to the nasal passages whereas the essential means of the process is the windpipe. He also attacks the mechanism directly by supposing that the expansion of the chest is due to the advance of blood and so argues that, contrary to Empedocles' explanation, inhalation is due to the advance of blood and exhalation to its retirement. Whether all animals breathe, he complains, Empedocles does not clearly state nor does he explain the purpose of the process.<sup>183</sup>

of the Atomic theory of respiration, although the heat which was rather a result of the mobility of the spherical atoms (cf. *De Caelo* 306 B 32-307 A 3) clearly played no part in this application. Aristotle himself confuses density and pressure as the result of cold whereas the Atomists, if they really attributed to the "soul" atoms a counter-pressure capable of withstanding the pressure of the body's environment, seem to have seen, however vaguely, that pressure may be explained by the velocity of atomic movement. In that case they could have responded to Aristotle's refutation that the pressure on the body in a warm environment is greater than that in a cold one.

<sup>182</sup> *Parva Naturalia* 473 A 15-474 A 23; Empedocles, *fragment* 100.

<sup>183</sup> Gilbert (*Meteorologische Theorien des Griechischen Altertums*, pp. 339, 343-344) believes that respiration served the same purpose in the biology of Empedocles as it did in that of Aristotle, namely the moderating of the *ἐμφυτον θερμόν*. He points out that this topic was borrowed by Aristotle from earlier medical theory which probably derives from Empedocles and that, since air



In the same way Aristotle attacks the ingenious theory of Democritus concerning the shedding of the milk teeth;<sup>184</sup> they are shed, he said, because they are premature growths, and they grow prematurely due to suckling. This explanation Aristotle first attempts to controvert by the statement that pigs do not shed their teeth and that some mammals with interlocking teeth such as the lion shed only the canines. On the basis of this false evidence he censures Democritus for stating a general rule without having examined all the phenomena. The notion that the milk teeth are premature he criticizes, moreover, on the ground that, if the natural time for their growth were later, there would then be a period after suckling during which these instruments necessary for taking food would be absent and "Nature would fall short of something possible for her." Besides, the explanation makes a constant natural occurrence the result of an unnatural force, for the production of teeth by suckling is a production by constraint. Aristotle himself employs the "necessity" of mechanical causation in accounting for stages in the growth of the teeth;<sup>185</sup> and finally criticizes Democritus not for the type of mechanism he uses but for failing to see that, whatever this mechanism may be, it is but an instrument of the final cause.

The criticism of earlier theories concerning the gall-bladder and its secretion is of the opposite nature, for Aristotle held

for Aristotle was θερμόν rather than ψυχρόν, it remained an alien inconsistency in his system (*ibid.*, pp. 380-383).

<sup>184</sup> *De Gen. Animal.* 788 B 10-29, 789 B 2-15 (cf. page 257 *supra*).

<sup>185</sup> *De Gen. Animal.* 788 B 3-789 B 2: The first teeth grow before the molars because their function (dividing) is prior to that of the molars (crushing) and because, being smaller, they are more quickly perfected. They are smaller because the jaw-bone where they grow is narrower and so furnishes less nourishment. They are shed because it is best for them to be shed, since they become dull and new teeth are needed, and necessarily because the narrow part of the jaw on which they grow furnishes a weak foundation for them. They grow again because the bone is still growing when the milk teeth are shed. This is an excellent example of the way in which mechanism and teleology are simultaneously employed by Aristotle. How on his own theory he could account for the phenomena he cites against Democritus, however, remains obscure. He tries to explain the varying periods required for the appearance of the milk teeth on the basis of the varying temperature of the milk imbibed, but this refers only to the comparative periods of different species of animals.

the gall to be residual matter and consequently believed that it does not exist "for a purpose." Anaxagoras and his school, according to Aristotle,<sup>186</sup> thought it to be the cause of acute diseases which resulted from an overflow of the excess gall into lungs, veins, and loins. Aristotle insists that most diseases of these parts are not attended by gall, implying that his dissections support him in this, and further holds that there is no relationship between the amount of gall being secreted and that which is present in diseased conditions. His final refutation, however, rests on the thesis that gall is just such a residual matter as the sediment of the bowels and is merely a necessary concomitant of a purposive process, not to be itself explained by reference to a final cause. This conception of the gall is sufficient refutation of the notion that long life is due to its absence,<sup>187</sup> a theory which arose, Aristotle thinks, from observation of the coincidence of longevity and absence of gall in solid-hoofed animals like the deer. The authors of such theories, in short, mistook necessary concomitants for efficient causes due to their ignorance of the relationship of efficient to final causality.

Neglect of the principle that the material and development of the organs of the body are determined by the service which they are to perform in the interest of the whole organism was, according to Aristotle, the reason for Democritus' mistaken notion that "bloodless" animals have viscera but that these are not apparent due to their small size.<sup>188</sup> Aristotle claims that the heart and liver are visible in sanguineous animals as soon as those animals begin to be developed, appearing like points in eggs of

<sup>186</sup> *De Part. Animal.* 677 A 5-19. Cf. also Hippocrates, *περὶ παθῶν*, § 1 (Littré, VI, 208): νοσήματα τοῖσιν ἀνθρώποισι γίνεται ἅπαντα ὑπὸ χολῆς καὶ φλέγματος, *ibid.* § 11 (Littré, VI, 218), § 15 (Littré, VI, 222); *περὶ λερῆς νόσου* § 15 (Littré, VI, 388); *περὶ φύσιος ἀνθρώπου* § 15 (Littré, 66); *Ἄφορισμοί*, 32 (Littré, IV, 584): ὁκόσοις δὲ χολώδεες αἱ ὑποστάσεις ἄνωθεν δὲ λεπταὶ δέξιν τὴν ἀρρωστήτην σημαίνουσιν.

<sup>187</sup> *De Part. Animal.* 677 A 30-35. Those who held this theory are referred to as τῶν ἀρχαίων οἱ φάσκοντες. They certainly include the Anaxagoreans just treated.

<sup>188</sup> *De Part. Animal.* 665 A 30-B 9. Democritus was using the argument from analogy probably to support the contention that the existence of material objects too small to be visible must still be assumed, so that the invisibility of the atoms is no reason for denying their existence. Cf. Lucretius, IV, 110-122.



three days, so that presumably the invisibility of the inwards of bloodless animals could not be due to minuteness but only to non-existence. The viscera, he says, are peculiar to sanguineous animals because they are serviceable only to them and consequently their material constituent is blood. They appear proportionately larger and more blood-like in the young of these creatures because in the early stages of development the material has not been completely subdued by the form. Not only is the form of the internal organs determined by their function which is dependent on the final cause but the matter of which they consist is determined in the same way. The function of the viscera being that of blood containers, the viscera must be unique to sanguineous animals; hence their material also must be unique and so of the nature of blood.

The organic processes are conceived by Aristotle to be the information of material which is represented in other words as the actualization of the form potential in matter. Such is the process of digestion which is understood to be a kind of concoction, the efficient cause of which is vital heat. That this process should result in anything other than the formation of blood is, however, impossible on Aristotle's principles of causation; but the existence of worms in the stomach seemed to be evidence of putrefaction rather than concoction, since putrefying matter was supposed to be the environment in which worms have their origin.<sup>189</sup> This difficulty Aristotle surmounted by denying that worms are generated in the stomach and supposing that they have their origin in the putrefying waste matter present in the lower intestines from which they work their way up into the stomach.<sup>190</sup> On the other hand, he could not admit that digestion is putrefaction, for the latter, being the contrary

<sup>189</sup> *Hist. Animal.* 539 A 21-25, 551 B 29-552 B 5; *De Gen. Animal.* 762 A 5-24.

<sup>190</sup> *Meteorology* 381 B 9-13. The theory that digestion is a kind of putrefaction was common to early medicine (cf. Galen, *In Hippoc. Aphor.*, VI, 1 [XVIII, 1, p. 8, Kühn]); Aristotle's specific references, however, are to details of this theory as held by Empedocles (*De Gen. Animal.* 777 A 8-12; *Topics* 127 A 17-19) on whom see Plutarch, *Quaest. Nat.*, 912 C (cf. Plato, *Phaedo* 96 B). To anyone who so conceived the process the presence of worms in the stomach was conclusive evidence of their origin there.

to the information of matter, could not in an organic process be an instrument of the final cause. For this reason he attacks Empedocles' description of the beginning of lactation, "on the tenth day of the eighth month it (i. e. blood) becomes a white suppuration."<sup>191</sup> Milk is a food and so potentially an animal body; as a stage in the process of organization it must be the result of digestion which is the opposite of putrefaction.<sup>192</sup>

The formative process is the result of the action of innate heat upon material; and the resulting combination, which is the material in a certain state or condition, may be considered from the point of view of substrate or that of form, although its own nature can be understood only as the resultant totality. Ignorance of these distinctions Aristotle blames for the debates as to whether blood, sperm, marrow, sap are hot or cold.<sup>193</sup> When seen in their natural condition they appear to be warm; when they are not in their natural state they are cold, for then the matter is losing or has lost the heat which informed it.<sup>194</sup> Similarly the various theories about the comparative temperature of different animals or of the sexes are really meaningless, Aristotle thinks, because they neglect to specify the mode of this variation they assume.<sup>195</sup> So some people thought aquatic ani-

<sup>191</sup> *De Gen. Animal.* 777 A 8-12. Aristotle suggests that this may have been only a poor metaphor; but it evidently was meant as a real explanation of the production of milk.

<sup>192</sup> In *De Part. Animal.* 675 A 13 Aristotle says that most fishes have appendages to the stomach in which they "putrefy and digest" their food (*συσσῆπωσι καὶ πέττωσι τὴν τροφήν*). This remark led T. E. Lones (*Aristotle's Researches in Natural Science*, p. 158) to say that Aristotle believed digestion was due to putrefaction. The passages already considered show that Aristotle vehemently attacked this theory, and the present phrase must be taken as a concession to ordinary terminology in a passage not directly concerned with the digestive process itself. The *καὶ πέττωσι* is a correction of the word *συσσῆπωσι*: "putrefy, that is digest."

<sup>193</sup> *Meteorology* 389 B 9-18, cf. *De Part. Animal.* 648 A 31-33. According to Hippocrates, *Ἀφορισμοί*, 63 (Littré, IV, 556), semen is not hot of its own nature. In the essay, *περὶ καρδίας* (Littré, IX, 92), the author says: *τὸ αἷμα οὐκ ἔστι τῇ φύσει θερμόν, οὐδὲ γὰρ ἄλλο τι ὕδωρ ἀλλὰ θερμαίνεται. δοκέει δὲ τοῖς πολλοῖσι φύσει θερμόν.*

<sup>194</sup> The material itself, however, varies in temperature, for that which is chiefly water is colder than that which is chiefly earth or air.

<sup>195</sup> *De Part. Animal.* 648 A 25-B 1.



mals must be warmer than animals that live on land, on the ground that the warmer nature of the former equalizes the cold of their environment;<sup>196</sup> some like Parmenides said the female has a higher temperature than the male,<sup>197</sup> while Empedocles held just the opposite.<sup>198</sup> Apart from the many different modes of activity and passivity according to which one thing may be said to be hotter than another and many of which are false distinctions due to the fact that Aristotle attributed too many physical phenomena to the action of heat and cold,<sup>199</sup> Aristotle draws a distinction between natural and accidental heat which shows that some things may be hot in the totality which comprises the union of substrate and accidents, matter and form, though not as regards the substrate alone.<sup>200</sup> It is in this way, he believes, that blood is hot; but the statements that such and such things are hot or cold he says can have no meaning until they specify whether the object has this characteristic 1) naturally or accidentally, 2) potentially or actually, and 3) in what mode, or to what effect.

The theory of Empedocles, however, he understands was

<sup>196</sup> The theory of Empedocles; the reasoning reproduced in *Parva Naturalia* 477 A 32-478 A 10 is different and more consistent with the Empedoclean type of explanation. The phrase *καὶ τὰ ἀναιμα τῶν ἐνάλμων* probably does not refer to an express statement of Empedocles, for he took no account of bloodless animals (cf. Theophrastus, *De Sensibus* 23 and 47); but it cannot refer to Parmenides (as Diels, *Fragmente der Vorsokratiker*, 18 A 52, seems to think) for the temperature of an animal must have varied directly with the quantity of blood on his theory. The phrase may be merely Aristotle's recasting of Empedocles' classification to make more apparent what he thinks is the absurdity involved. There is certainly a reference to this theory of Empedocles in the introduction of the material *κρᾶσις* as a basis for the classification of animals in *Hist. Animal.* 589 A 11-590 A 18.

<sup>197</sup> The argument that the menses are due to the higher temperature is Aristotle's reconstruction. It is more likely that Parmenides thought the menses evidence of an excess of blood and supposed that the body-heat depended upon the amount of blood present (cf. *De Gen. Animal.* 765 B 19-28).

<sup>198</sup> Cf. Empedocles, *fragments* 65 and 67; Aëtius, V, 7, 1 and (for the opposite view of Parmenides) V, 7, 2.

<sup>199</sup> *De Part. Animal.* 648 B 11-35. E. g. boiling water is hotter than a little fire but cools more quickly and more thoroughly and in this sense is colder than fire; blood is warmer to the touch than water or oil but solidifies faster and so is colder than they.

<sup>200</sup> *De Part. Animal.* 648 B 35-649 A 17.

meant to refer to the inherent characteristics of the material constituent of animal bodies; Empedocles said that aquatic animals originated on land but, consisting to a great extent of fire, they took to the water in order to escape the excessive heat of their own bodies and preserve themselves by tempering that excess with the opposite characteristic of their environment.<sup>201</sup> Aristotle saw in the generalization of this principle the destruction of his whole teleological system; his doctrine of hypothetical necessity required that the material of an organism be determined by the environment in which that organism was to exist, and this he developed to mean that each consists largely of the matter which is its habitat.<sup>202</sup> Against Empedocles he objects first that it is absurd to suppose that *every* individual fish which came into existence on land should have migrated to water, particularly since most of them have no feet. Unfortunately it is evident from Aristotle's way of putting this last that he did not mean it as a joke. As for the first part of the argument, it is strange that he did not see that Empedocles meant it to apply to the original ancestors of the aquatic species; difficult as the notion is and open as it may be to refutation, Aristotle is awkward in interpreting as the history of each individual what was meant to portray "the history of the species." His second objection is that these animals are obviously not hotter than land animals, for they are all either bloodless or endowed with very little blood. The final and most important argument, however, consists in making a distinction between the material substrate with its inherent characteristics and the accidental states and qualities attaching to it. The latter when excessive he admits may be "preserved" by their opposites inasmuch as they are thereby brought back to their proper measure; but the former is always destroyed by its opposite. It is, consequently, necessary that the body of an organism be constructed from the material environment in which it is meant to live.

Conformably with his general doctrine Aristotle believed that the construction of a new creature must be explained as a com-

<sup>201</sup> *Parva Naturalia* 477 A 32-478 A 10. Cf. Theophrastus, *De Causis Plant.* I, 21, 5 ff.

<sup>202</sup> Cf. *Parva Naturalia* 477 A 25-31.



bination of matter and form which are contributed to the offspring by the parents. The latter he thought was carried by the sperm of the male, the former was to be identified with the catamenia of the female, both sperm and catamenia being the surplus of the final stage of formation of the blood in the two sexes and different from each other to the extent that the female lacks the amount of vital heat necessary to inform the catamenia completely and so change it into sperm.<sup>203</sup> This analogical relationship of sperm and catamenia in conjunction with his axiom of the economy of nature causes him to deny that the female contributes "seed," that is any formative element, to the offspring;<sup>204</sup> there were those, however, who thought that reproduction was in some way the result of the mixture of seeds furnished by both parents,<sup>205</sup> and Aristotle attempts to refute this theory both from empirical evidence and on the basis of what he considers incontrovertible philosophical axioms. Even where he uses accurate observations against rival embryological theories, however, his interpretation of these observations and the foundation of his criticism are always determined by the fundamental distinction between formal and material causation. One of the arguments for the notion that the female contributed seed seems to have been that she experiences pleasure in intercourse, a fact which evidently was taken as proof of the theory that the vulvo-vaginal discharge, which was observed, is an important secretion of like nature to the male semen;<sup>206</sup> Aristotle contends that this discharge is not "spermatic" but is peculiar to the part from which it is discharged and varies in different

<sup>203</sup> Cf. *De Gen. Animal.* 726 B 1-727 A 4, 728 A 17-30.

<sup>204</sup> *De Gen. Animal.* 727 A 25-30.

<sup>205</sup> Cf. Hippocrates, *περὶ γονῆς*, §§ 4, 5, 6, 12 (Littré, VII, 474, 476, 478, 486); a similar theory is ascribed to Pythagoras and Democritus by Aëtius (V, 5, 1) and to Anaxagoras, Alcmaeon, Parmenides, and Empedocles by Censorinus (*De Die Natali*, V, 4). For Parmenides cf. *fragment* 18 and for Empedocles *fragment* 63 (quoted by Aristotle in *De Gen. Animal.* 722 B 12-13).

<sup>206</sup> *De Gen. Animal.* 727 B 33-728 A 1. On the relation of the pleasure felt in intercourse to the discharge cf. Hippocrates, *περὶ γονῆς*, § 4 (Littré, VII, 474-476), especially: *διότι δὲ μᾶλλον ὁ ἀνὴρ ἡδεται, ἀποκρίνεται αὐτῷ ἐξαπλῆς ἀπὸ τοῦ ὕγρου ἀπὸ παραχῆς ἰσχυροτέρας ἢ τῇ γυναικί*. Where no discharge was apparent it was supposed that it had occurred in the womb and the moisture was retained there.

women, the amount of the discharge being capable of augmentation by a variation in diet.<sup>207</sup> The discharge takes place not in the womb but in front of it, in the same region where the seminal discharge of the male occurs;<sup>208</sup> if this discharge, then, is the feminine contribution to the offspring, he argues that it must be drawn up into the uterus to mix with the male sperm, and, since such a process would be superfluous, it is for Aristotle impossible. Nature does nothing superfluous. The evidence of the female's pleasure in intercourse he treats as a separate argument and answers that conception frequently takes place even when no pleasure has been experienced and that, even when the female has an orgasm in copulation, conception is impossible unless the catamenial fluid is present in the proper quantity,<sup>209</sup> whereas the pleasure is due not merely to ejaculation of seed but also to the accumulation of "pneuma" which causes ejaculation.<sup>210</sup> The pleasure is felt by the female, moreover, in the same region as it is felt by the male; on the assumption that

<sup>207</sup> *De Gen. Animal.* 727 B 36-728 A 9.

<sup>208</sup> *De Gen. Animal.* 739 A 35-B 20. Hippocrates, *περὶ γονῆς*, § 4 (Littré, VII, 474-476) implies that the seminal discharge takes place inside the uterus (*ἐξαίσσει δὲ ἡ ἡδονὴ καὶ ἡ θερμὴ ἅμα τῇ γονῇ πιπτοῦσα ἐς τὰς μήτρας, ἔπειτα λήγει*); the notion that the vulvo-vaginal discharge is the female contribution of seed required the theory that it occurred within the uterus, the moisture observed outside being due to leakage through the *os uteri* (cf. Hippocrates, *ibid.*: *μεθίει δὲ καὶ ἡ γυνὴ ἀπὸ τοῦ σώματος ὅτε μὲν ἐς τὰς μήτρας . . . ὅτε δὲ καὶ ἔξω, ἣν χάσκωσιν αἱ μήτραι μᾶλλον τοῦ καιροῦ*). Aristotle supposes that the sperm discharged in front of the *os uteri* is drawn into the womb by the heat in that organ and uses the comparison of the "attraction" of water by heated conical vessels. (He objected to the analogy of cupping-glasses to explain the movement of semen to the testes [cf. page 209, note 245 *supra*], and his present remark that the attraction attributed by some to the copulative organs [the meaning of the sentence is mistaken by Platt in the Oxford Translation] does not occur is meant to emphasize the distinction between his use of the mechanism and that to which he previously objected.)

<sup>209</sup> *De Gen. Animal.* 727 B 5-30.

<sup>210</sup> *De Gen. Animal.* 728 A 9-14. Aristotle's phrase (*ἐξ οὗ συνισταμένου ἀποσπερματίζει*) is unfortunate, for if the female does not ejaculate seed there is no reason to suppose that this "pneuma" accumulates in her. But he probably means that attrition causes in her an accumulation of "pneuma" which precedes the vulvo-vaginal ejaculation. Elsewhere, however, he objects to the Hippocratic theory that the ejaculation of seed is due to the force of breath (cf. page 209, note 245 *supra*).



the catamenia are the female contribution to the formation of the offspring, Aristotle argues, then, that, since they do not spring from the region where pleasure is felt in coitus, the pleasure is no evidence that the female contributes seed.<sup>211</sup> In all production, he resumes, there must be agent and patient different in form and essence; where the sexes are distinguished in different bodies it necessarily follows that the male is the active and the female the passive principle, so that one furnishes the efficient cause and the other the material to be worked.<sup>212</sup>

The semen as the efficient cause carrying the form which it imposes upon the material supplied by the female is naturally for Aristotle the result of a process of organization, and his antipathy toward the theory that the seed is derived from all parts of the body was primarily due to the fact that for him such an explanation must make the semen the result of decomposition.<sup>213</sup> To say that the semen comes from all the body due to the heat generated by copulation<sup>214</sup> amounts to making it a waste-product, he says; but a waste-product is contrary to nature (by which he means that it is the result of a separation of matter and form) and from such a thing can arise nothing which is according to nature. Consequently the seed must be a secretion and a useful secretion, that is something which can contribute to further growth. Further, it is part of the final stage of the digestive process, that from which every part of the body comes to be. Aristotle, then, declares the seed to be that which would naturally *proceed to* every part of the body rather than that which *comes off* of every part, for it cannot like a waste-product be a stage of decay. That large animals have fewer young than small animals is, he thinks, a proof of his contention, for they must have the most waste and the least superfluous secretion of the ultimate food inasmuch as they use up most food in pro-

<sup>211</sup> *De Gen. Animal.* 728 A 31-34.

<sup>212</sup> *De Gen. Animal.* 729 A 20-33.

<sup>213</sup> *De Gen. Animal.* 724 B 34-725 B 4. That the seed comes from all parts of the body is Hippocratic doctrine; cf. Hippocrates, *περὶ γονῆς*, § 32 (Littre, VII, 542). The theory was held by Democritus, also (cf. Aëtius, V, 3, 6), and, as will be seen, in a special sense by Empedocles.

<sup>214</sup> This mechanism is explained in detail in Hippocrates, *περὶ γονῆς*, § 1 (Littre, VII, 470) where the spinal marrow plays an important rôle.

ducing the great size of their bodies. The seed is proved to be a secretion also by the fact that it has a natural receptacle as do all secretions, whereas waste-products have none.<sup>215</sup> The arguments in favor of the Hippocratic theory Aristotle reduces to four and answers them partly with evidence to the contrary, partly by presenting logical difficulties which he considers insoluble according to the hypothesis.<sup>216</sup> The evidence on which the theory relies is 1) the violence of the pleasure in intercourse which seems to reach every part of the body, 2) the fact that mutilated parents beget mutilated offspring,<sup>217</sup> 3) the similarity of offspring to parents not only as a whole but in specific parts, 4) the deduction that since there is a beginning from which the whole arises so there must be for each part, so that if the seed is the origin of the whole there must be a particular seed for each part. The first argument is answered by the counter-theory that the pleasure is due to the strong titillation, as is shown by the fact that if this be dulled by frequent indulgence the pleasure is diminished, and by the objection that on the theory the pleasure ought not to occur in all the parts of the body at the same time. The second argument is denied; the offspring of mutilated parents may be whole and sound, but, if they are mutilated, the fact is to be explained in the same way as is the similarity of parent and offspring. The third and fourth arguments are considered together and at greater length. In the first place, he says that offspring resemble their parents in parts from which no seed could have been derived,<sup>218</sup> while offspring develop certain characters, such as the beard, which their parents did not yet have when begetting them. Further, children often resemble more distant ancestors from whom no seed has

<sup>215</sup> Cf. page 209, note 245 *supra*.

<sup>216</sup> *De Gen. Animal.* 721 B 13-724 A 11.

<sup>217</sup> The Hippocratics, however, seem not to have claimed that mutilations as such are hereditary (cf. Hippocrates, *περὶ γονῆς* § 11 [Littre, VII, 484]).

<sup>218</sup> Such as voice, nature of movement, hair, nails. The last two cannot give rise to seed because, presumably, there are no blood-vessels leading from them. The *ὁδοί* along which the sperm is carried to the spinal marrow (Hippocrates, *περὶ γονῆς* § 1 [Littre, VII, 470]) are called *φλέβες καὶ νεῦρα*. The first two are of a different nature and need not have occasioned difficulty to the supporters of pangenesis.



come to them. The descendants of plants of which some part has been removed will still have that part; and, though the pericarp could not contribute to the seed, all plants produce a pericarp just like that of the parent. In the second place, since the heterogeneous parts of the body consist of the homogeneous parts, Aristotle asks from which the seeds come; offspring resemble the parent rather in the heterogeneous parts than in the others, yet the homogeneous parts are prior as constituting the heterogeneous, and the seed cannot come from both because the heterogeneous parts are simply *arrangements* of the homogeneous material. The point is that it is not only a similarity of matter which has to be explained but a similarity of form also; this distinction was not made by the earlier thinkers who apparently treated formal difference as a characteristic of the matter involved. For Aristotle, however, the formal cause is the vital principle logically separate from matter and dominating it; and so he argues that, if this is not present already in the seed, the parts which are there will exist separately and so cannot live but, if it is present, the articulated animal is already present in miniature. In that case, there would be two complete animals, one in the seed of either parent; if the similar parts of these two combine to form a single part, the genital organs present difficulty for they would be different in the two seeds. Here Aristotle does not consider the mechanism used by Democritus and the Hippocratics to explain this difficulty, namely the struggle between the two seeds; he comes back to that in discussing the determination of sex but at present considers the modified form of the theory represented by the notion of Empedocles that *part* of the offspring exists in the seed of one parent and the complement in the seed of the other.<sup>219</sup> This explanation,

<sup>219</sup> He quotes from Empedocles ἀλλὰ διέσπασται μελέων φύσις· ἡ μὲν ἐν ἀνδρὶ . . . (cf. *fragment* 63; Diels refers to Plato, *Symposium* 191 D which seems to be developed from the ideas contained in these words and in *fragment* 64). Aristotle clearly thinks that this "division" and "tallying" in Empedocles' theory means that the seed of some whole parts come from one parent, that of the other parts from the other. If that is the correct account, there could be no struggle in the development of the embryo to decide in the case of any one part whether it should resemble the mother or the father. But Philoponus (*De Gen. Animal.*, 166, 26-36) gives a different explanation according to which

however, is as impossible, he says, as the notion that full-grown parts of the body live in isolation, the state of affairs which Empedocles describes in "the period of Love,"<sup>220</sup> for the sun-dered parts could not exist unless they contained soul or the life-principle and, if they did, they would be individuals which could not combine to form a new individual. Moreover, the homogeneous parts are defined by certain qualities, the heterogeneous parts by certain functions which do not exist in the seed, so that, even if part of the semen comes from blood, the part that has come away can no longer be called blood; the mechanism for explaining similarity, therefore, disappears and with it the reason for deriving the seed from all parts of the body. Aristotle then says that, in so far as this theory implies that none of the homogeneous parts come into being, it is a biological application of the universal theory of Anaxagoras; but these biological investigators were inconsistent, for they supposed that the food added to the growing seed can change, whereas Anaxagoras explained the growth of flesh by the addition of the particles of flesh present in the food. If then the food can change into blood, flesh, etc., one may better say that the seed is of such a nature that these parts can come to be from it rather than that it itself *is* these parts. Finally the facts that some animals produce offspring in the form of scoleces which are entirely unlike the parent, that some produce many offspring as the result of one coition,<sup>221</sup> that plant cuttings bear fruit and

*half of every part* is represented in the seed of each parent. If the uterus is warm the *half* seed of a given part from the male changes the *half* from the female into its own nature and the whole part in the offspring comes to resemble that part in the father. Philoponus goes on to say (*ibid.*, 166, 37-167, 5) that, in the male, half of every part is female and in the female, half of every part is male. His citation of Empedocles shows that this refers to the individual, not to the seed; and it is clear that Empedocles here had a vague notion of the persistence of the recessive characteristics in each part of the body. In the seed, however, only the dominant half is represented. Aristotle's mistaken interpretation was due to his notion that Empedocles' embryology must be similar to his description of the origin of animals in the period of "Love" (cf. next note).

<sup>220</sup> He quotes the first line of *fragment* 57 and says that these single limbs were then joined together to form whole animals (cf. *fragment* 59 and Simplicius, *De Caelo*, 587, 18-19).

<sup>221</sup> This argument is repeated in *De Gen. Animal.* 729 A 4-8. Aristotle



so even before the severance bore fruit from themselves and not from the whole plant appear to Aristotle to prove that the seed does not derive from all the parts of the parent, while his mistaken notion that in some insects the female penetrates the male who does not emit sperm enables him to believe that the form may be transmitted to the female matter apart from a material vehicle which might seem to come from all parts of the body.<sup>222</sup> In short, even if some part of the parent comes off in the seed, it is only part of the effective principle, for the material is insignificant; it is the efficient cause of the new animal that the male parent contributes.

The question of the determination of sex was treated by the Presocratics as one phase of the problem of the similarity of offspring to the parents, and Aristotle followed them in this; the course of the development of the embryo and all the results of this development depend for him upon the extent to which the formal cause as represented by the male semen and its power subdues the material which is the catamenial fluid. To Anaxagoras and other unnamed physical philosophers Aristotle attributes the theory that the distinction of sex exists in the sperm itself, the male sperm coming from the right testicle and the female sperm from the left, while the female provides only a place for its development; the male, however, develops on the right side of the uterus, the female on the left.<sup>223</sup> Empedocles

argues that the whole litter may resemble the male parent in one part, yet the seeds from that part could not have been kept separate in emission nor could they have been separated in the uterus, for such a separation would be really the division of an individual. This reasoning depends upon the notion that the male sperm and female matter are each an unit and so really begs the question.

<sup>222</sup> Cf. his belief that the hen partridge may be impregnated if she stands to windward of the cock (*Hist. Animal.* 560 B 13-16).

<sup>223</sup> *De Gen. Animal.* 763 B 30-764 A 1. The confusion of the accounts in Censorinus has induced scholars to reject his statements concerning the embryological theories of Anaxagoras where they disagree with this remark of Aristotle (Diels, *Doxographi Graeci*, pp. 191 ff.; Zeller-Nestle, *op. cit.*, I, p. 1247, n. 2). The constant association of Anaxagoras and Parmenides in embryological accounts (Aëtius, V, 7, 4; Censorinus, *De Die Natali*, V, 4 and VI, 6 [where *Parmenides* should be substituted for Empedocles cf. Diels, *op. cit.*, p. 192]) in conjunction with the fact that Parmenides believed that both female and male contributed seed (*fragment* 18; cf. Censorinus, *op. cit.*, VI, 5) suggests the

made the cause of the differentiation the temperature of the uterus; if this was warm the entering seed became a male, if cool a female.<sup>224</sup> The cause of the variation in temperature he took to be the catamenia.<sup>225</sup> Democritus also held that the sex is determined in the uterus, but he thought the determination the result of a struggle between the two sets of seeds. In this struggle the seeds from each part of the parent bodies acted as individuals, so that the seed from one part of the mother might conquer while in the case of another organ the seed from the father might be the victor.<sup>226</sup> The distinction of sex, then, de-

probability that Aristotle's account here is not complete. The distinction of right and left (cf. Aëtius, V, 7, 4; V, 11, 2) certainly was due to an assumed difference of temperature (cf. Aëtius, V, 7, 2) in the two sides of the body which, corresponding to the difference in the heat of the two sexes, determined from which side male and from which female seed should come. If Anaxagoras held that both parents contribute seed (and this is highly probable), he must have made a similar use of the effect of the position in which the foetus develops. These theories which supposed that the male contributes male seed from the right testicle and female seed from the left must have held that the female also has male seed on the right side of the uterus and female seed on the left side. Male semen joining with male seed from the uterus (on the right side) would produce virile males; if male seed fell on the left side of the uterus, an effeminate male or a boy resembling the mother would result. By neglecting the element of the female's contribution, Aristotle fell into the error of supposing that the effect of the female on the sex of the offspring was due to the *position* in the uterus as such.

<sup>224</sup> *De Gen. Animal.* 764 A 1-6.

<sup>225</sup> There are two causes for this difference as given by Aristotle. The catamenial fluid itself may be warmer in some females than in others; and any one uterus will be warmer the more recently the menses have occurred. Reference is made in *De Gen. Animal.* 723 A 23-26 to Empedocles' theory that the differentiation of sex takes place at conception. There Aristotle quotes a line and a half of Empedocles (*fragment* 65): "They (the seeds) are poured into pure receptacles; those that come in contact with cold become women." The importance of the temperature in Empedocles' theory lies in the fact that it determines whether the male or female seed shall conquer in the struggle (cf. Diels, *Doxographi Graeci*, pp. 192-193); contrary to the theory of Parmenides, the temperature here does not create a distinction of sex in the seed itself (cf. page 274, note 219).

<sup>226</sup> *De Gen. Animal.* 764 A 6-11. The male and female seed on this theory represent each a complete body, and the struggle occurs between the pairs of seed from each part (cf. Aëtius, V, 7, 6; the explanation of Philoponus [*De Gen. Animal.*, 167, 19-32] implies that the decision of the struggle between the



depends upon which seed from the sexual organs overcomes the other. Aristotle's attack on Empedocles' theory at this point<sup>227</sup> is largely captious. He says that the great difference in the sexual parts is not to be attributed to difference of temperature alone; and he says that for Empedocles an animal having all the female parts, if put into a warm uterus, would nevertheless become a male. This criticism simply neglects the use which the theory made of temperature as the determining agent in the struggle of the germs for dominance; and the fact that Aristotle praises the theory of Democritus in comparison because it sought to explain the difference in the generation of the sexual organs shows that he missed entirely the element of struggle in Empedocles' genetic theory.<sup>228</sup> He even objects that Empedocles makes heat and cold the causes of the difference of sex but fails to say that they are the causes of the difference between the male and female organs, an objection which would be meaningless for Empedocles; Aristotle, however, in proceeding to

seeds representing the sexual organs determines the victory of the seeds from which all the other parts grow; this cannot be right, for it would deprive the theory of the means of explaining how the male child could resemble the mother in some parts and *vice versa*, obviously one of the chief purposes of the hypothesis). In *De Gen. Animal.* 723 A 23-B 3 Aristotle says that the fact that the same man or woman has now male and again female offspring is presumptive evidence against pangenesis and suggests that the cause of the offspring's sex is rather the proportion or disproportion of the contributions from the two parents or some such thing. This evidence seems to show that the same seed is potentially either sex and consequently that the sexual organs are not the result of a specific origin of the seed in some part of the parent. If, then, seed does not come from one part, the sexual organs, it is inconsistent to suppose that it comes off of the other parts. This is meant to be a general refutation of pangenesis including the theories of Empedocles and Democritus; and it is possible that Democritus failed to give a definite reason why one seed should now conquer and again be subdued; the way in which he probably thought of this phenomenon is suggested, however, by the clear statements in Hippocrates, *περί γονῆς*, §§ 6 and 8 (Littré, VII, 478 and 480): *ὅτι μὲν ἰσχυρότερόν ἐστι τὸ μεθιέμενον ἀπὸ τῆς γυναικὸς, ὅτι δὲ ἀσθενέστερον· καὶ τὸ ἀπὸ τοῦ ἀνδρὸς ὡσαύτως . . . καὶ ἐν αὐτῇ τῇ γονῇ ἐξέρχεται καὶ τῆς γυναικὸς καὶ τοῦ ἀνδρὸς ἀπὸ παντὸς τοῦ σώματος, καὶ ἀπὸ τῶν ἀσθενέων ἀσθενῆς καὶ ἀπὸ τῶν ἰσχυρῶν ἰσχυρή* (cf. *περί ἀέρων* κτλ., § 14). Empedocles, however, attributed the outcome to the varying temperature of the uterus.

<sup>227</sup> *De Gen. Animal.* 764 A 12-B 20.

<sup>228</sup> Cf. page 274, note 219 *supra*.

say that, even if temperature were the cause of this difference, it is important to show how that difference follows necessarily from that cause indicates the motivation of this objection. He himself makes the difference in vital heat the origin of the difference in sex; and the apparent similarity of Empedocles' theory evidently vexed him, for he carefully shows how the different sexual organs are necessary as the natural receptacles of the blood concocted to different degrees of perfection in the two sexes as a result of the different intensity of their vital heat. One piece of real evidence, however, he does adduce, namely that twins, of which one is male and the other female, are to be found in the same part of the uterus; there could be no question of variation of temperature here, so that on Empedocles' theory both twins should have been of the same sex. As for the notion that the parts exist "sundered," some in the mother and some in the father and that this is the reason they desire intercourse,<sup>229</sup> the sexual parts, too, would then be separated and would come into being by conjunction and not because of heating or cooling. This criticism like the first one mentioned ignores the relationship of the two elements in Empedocles' theory; it does, however, hint at a real difficulty, namely the existence in the seeds of the bodily parts already *actually formed*.

Aristotle's theory that the semen does not come from the whole body and that the male contributes no material but only form is enough, he thinks, to refute Empedocles, Democritus, and the believers in pangenesis generally, for it does not allow the seed to be split apart as Empedocles says or to exist whole

<sup>229</sup> Cf. Empedocles, *fragment* 64. Aristotle interprets this to mean that the whole parts represented in the seed of the male desire conjunction with the germs in the female seed representing *different* whole parts of the body. Philoponus (*De Gen. Animal.*, 166, 37-167, 2) seems to think that the "recessive" female halves of each part in the male and the "recessive" male halves in the female are the cause (at least in part) of this desire; but this is inconsistent with his previous account of what takes place in conception and entirely at variance with the general notion of the "sundering" in Empedocles' theory. Philoponus' mistake is due to confusion of the state of the parent body and that of the seed. The desire is, evidently, that of the "dominant" halves, which alone are represented in the seed, for each other, e. g. of the male half of the heart in the male seed for the female half in the female seed.



as a separation from either parent severally so that a struggle between the parts of the two homunculi could result in an individual either male or female.<sup>230</sup> Although Aristotle professes to believe that the theory of Democritus is superior to that of Empedocles because it explains how the embryo attains one sex or the other as a consequence of the outcome of the struggle between the germs from which the sexual organs arise, he points out that the differentiation of sex always entails a definite set of organs which invariably occur along with the uterus or penis and objects that the theory of struggle between the germs of each part should result in a great number of various combinations.<sup>231</sup> If it were supposed that the victory of one germ in the primary sexual organs determines the victory in the others because they are adjacent, then a girl ought always to resemble the mother in all parts and a boy the father, for the same principle of propinquity would apply to all the parts.<sup>232</sup> But particularly he objects to the implication that the sexual organs, by being determined alone, determine the sex; the difference of sex is a difference of the whole body, and the sexual organs as merely receptacles designed for a certain kind of blood are determined by the blood and are posterior to the vascular system which as efficient cause of these organs determines their nature by its own specific character. These organs, then, are only the concomitant result of the first principle of development, whatever that may be; and by this criticism Aristotle returns to the foundation of his objection, namely that the theory of Democritus fails to take cognizance of the necessary subordination of the material and its development to the prior final cause.

Against those who say the male comes from the right and the

<sup>230</sup> *De Gen. Animal.* 764 B 10-20.

<sup>231</sup> *De Gen. Animal.* 764 B 20-765 A 3.

<sup>232</sup> This is the way in which Philoponus represents the theory of Democritus. The implication of the remarks of Aristotle, however, is that the original theory was not consistent in this matter but supposed that the female seeds could conquer in the sexual organs and produce a female who would still resemble the father in certain parts where the male seed had conquered (cf. page 277, note 226 *supra*). Aubert-Wimmer note that Aristotle himself adopts the notion of dominance modified only by a distinction of characteristics in the parent which dominate now as a system and again as parts (cf. especially *De Gen. Animal.* 768 B 2-15).

female from the left<sup>233</sup> Aristotle says that, if the male contributes no material, there can be nothing in this theory; but, even if matter is contributed by the male, the same objections are valid against this notion as were urged against Empedocles. Difference of position can be no more reason for development of an uterus than temperature;<sup>234</sup> and, anyway, a male has been found on the left side of the uterus and a female on the right and both on the same side.<sup>235</sup>

Aristotle, however, has himself to admit that variation of temperature is in a way the cause of sexual differentiation and, since he believes the right side to be warmer than the left, that the side from which the semen is secreted has some effect upon the result, for the thicker semen is more fertile and it is the more highly concocted that is thicker while, again, the more highly concocted is warmer and so must come from the right side.<sup>236</sup> His objection to the manner in which earlier theories used these concepts is that they did not elucidate the connection of the results with the first principles, that is did not show how the

<sup>233</sup> *De Gen. Animal.* 765 A 3-21. The course of the argument shows that "from the right and left" means from the right and left testicles as well as from the sides of the uterus. In short, this is a refutation of such theories as that attributed to Anaxagoras.

<sup>234</sup> This argument assumes that there was no further cause than mere position in the uterus. It does not consider the fact that some, at least, of the believers in this theory thought the female contributed seed which was undoubtedly thought to be different in character or development depending on the side of the uterus from which it came (cf. page 276, note 223 *supra*).

<sup>235</sup> This evidence does not invalidate any theory which attributed a different character to the semen coming from the right and left testicle. Although Aristotle shows that the theories he is criticizing did indeed attribute some effect of difference to the character of the male sperm (*εἴτε γὰρ μηδεμίαν ὕλην συμβάλλεται τὸ ἄρρεν οὐθὲν ἂν λέγοιεν οἱ λέγοντες οὕτως.*), he proceeds to argue as if the position of the foetus in the uterus were the only determinant. He then (*De Gen. Animal.* 765 A 21-34) refers to some who adopted a similar view and supported it by experiment, saying that, if one copulates after tying up one or the other testicle, the offspring will be male or female respectively, as Leophanes claimed for one and as some said occurs when one testicle has been cut out. This Aristotle says was not observation but mere guessing. He insists that the testicles do not contribute to the differentiation of sex because he believes that many animals without testicles get sexually differentiated offspring.

<sup>236</sup> *De Gen. Animal.* 765 A 34-B 6.



final cause accomplishes itself by imposing the form upon the matter by the agency of a series of efficient causes. For the elucidation of his further criticism it is necessary to resume in brief the manner in which he accomplished this end.<sup>237</sup> The male he distinguishes from the female by the power the former has to concoct blood into semen which carries the principle of form that acts as a first efficient cause; and, since concoction is due to heat, he decides that the male is warmer than the female.<sup>238</sup> The two sexes have different organs because they work up their nutriment to different degrees of excellence, the faculty and the organ developing at the same time. Since the male and female are, as such, opposites, when the first principle in the homunculus cannot fully concoct the nourishment due to lack of heat, the material is not brought over to the form of the principle but changes into the opposite of this and becomes female and the change of one important organ entails a similar change in the other parts of the constitution. The male and female differ as capability and incapability of concocting the ultimate nutriment which is blood or its analogue, and the cause of this capability and incapability lies in the part which possesses the principle of natural heat, namely the heart. Consequently the principle of sex is the heart, although the animal is male or female only after having assumed the appropriate organs the difference of which results from the different nature of the material, that is the blood, from which they are constructed. The perfection of the animal depends upon the extent to which the form carried by the semen predominates over the material of the catamenia; and naturally Aristotle seeks to attribute all imperfection to the resistance of the latter. It is obvious that if the

<sup>237</sup> *De Gen. Animal.* 765 B 8-766 B 26.

<sup>238</sup> Here (765 B 18-35) he turns aside to say that the menses are a sign of lack of heat in women not of excessive heat as some think (Parmenides thought the female hotter than the male, cf. Aëtius, V, 7, 2, and probably for this reason; the Hippocratic doctrine made the menstrual purgation one cause for the lower temperature of the female, cf. Hippocrates, *περί διαίτης*, § 34 [Littré, VI, 512]), who were drawn to this conclusion by a mistaken conception of the nature of blood. The purer the blood, i. e. the more highly concocted it is, the smaller its quantity. The menstrual fluid surpasses its analogue, the semen, in quantity just because it is not blood in such a pure form as the latter.

semen completely dominates the matter in every particular the child will be exactly like the father; the various extents to which this information may take place or fail to take place Aristotle motivates by assuming various "movements" in the sperm which so set the matter in motion as to bring out different characteristics in the offspring, but the passive resistance of the catamenia must also be broken up into "movements," and as the formal cause in the sperm turns out to be really a whole nest of forms so the various moments of resistance in the matter assume in effect the nature of formal causes. It is, however, by this means that the difference of sex and the similarity of children to parents or ancestors in one part or another are explained.<sup>239</sup> This brings him to criticize a theory which he attributes to certain physical philosophers who sought to explain the similarity of children to parents by saying that the offspring resembles that parent from which it has derived the more seed whether in whole or in any particular part.<sup>240</sup> If pangenesis is

<sup>239</sup> Cf. *De Gen. Animal.* 767 A 36-768 B 36.

<sup>240</sup> *De Gen. Animal.* 769 A 9-26. Censorinus (*De Die Natali*, VI, 4) ascribes to Alcmaeon the theory that the sex is determined by the parent from whom comes the greater quantity of seed and to Anaxagoras (*ibid.*, VI, 8) the explanation of resemblance of offspring to parents on the same ground. Lactantius (*De Opific.*, XII, 12) gives the same theory in greater detail, and Diels (*Doxographi Graeci*, p. 193) takes the statement of Lactantius and the present passage of Aristotle to refer to Anaxagoras. Aristotle, however, implies that his account includes two schools, one which explained resemblance as due to the quantity of seed but the determination of sex in the way Empedocles or Democritus explained it and another which explained both sex and resemblance on the basis of the quantity of seed. Anaxagoras could not have belonged to either classification so far as determination of sex is concerned (cf. *De Gen. Animal.* 763 B 30-764 A 1 and page 276, note 223 *supra*). The comparative simplicity of the theory of the overbalancing quantity of seed from one parent or another shows it to be older than the theory of Empedocles, and it probably was that of Alcmaeon; but in that case it could hardly have included the element of pangenesis. This should evidently be restricted to the first of the two types mentioned here; and in the Hippocratic writings we have a genetic theory which fits this description, although Aristotle does not do justice to its complicated nature. Each parent secretes both male and female seed and furnishes seed from every part of the body. The seed from the male is stronger than that from the female; but the strength of the seed from each part of the body depends upon the vigor of that part at the time of separation. Furthermore, the quantity of seed secreted from each part also varies, and the struggle that



false, Aristotle answers, this cannot be the explanation of resemblance; even if it is true, this theory still has difficulty in explaining how a child of one sex can resemble the parent of the other sex, for the explanation of Democritus and Empedocles has been proved impossible<sup>241</sup> and those who explain the determination of sex by the quantity of the seed *alone* have no way of accounting for the phenomenon since a *larger* quantity cannot be furnished by both parents. Nor can they tell why children resemble more distant ancestors,<sup>242</sup> since no seed comes from them.<sup>243</sup>

ensues between the seeds from the two parents is decided not merely by the strength of the seeds but by the proportion of strength and quantity (Hippocrates, *περὶ γυνῆς*, §§ 6-8 [Littré, VII, 478-480]; *περὶ διατρῆς*, §§ 28-29 [Littré, VI, 502-504]).

<sup>241</sup> And the Hippocratic explanation of the sexual determination was much the same, inasmuch as it resulted from a struggle between male and female seeds. It was more complicated, however, than either that of Democritus who assumed a whole male seed and a whole female seed concerned or that of Empedocles who assumed a half-seed of the female organ and a half-seed of the male contending, for it assumed both male and female seeds in each parent either of which could be emitted in any one coition (cf. *περὶ διατρῆς*, §§ 28-29 cited in the previous note).

<sup>242</sup> Aristotle goes so far as to say here that children "generally" resemble their grandparents or more remote ancestors, which is not true. Platt remarks that an answer might easily enough have been given to the question. Certainly it would have been no more difficult for the theory criticized than for Aristotle's own.

<sup>243</sup> Aristotle next (*De Gen. Animal.* 769 A 28-B 2) refers to a theory which Aubert-Wimmer seem to identify with that of Democritus. It is, however, quite different, and Aristotle treats it as separate from all he has thus far mentioned. It treated the seed as a unity, a *πανσπερμία* and supposed that the mixture of seed from the male and female in different proportions would explain all variations in the offspring since the seed of neither is an even homogeneity. This theory Aristotle says is fanciful but thinks it better than any he has mentioned because its term, *πανσπερμία*, comes near to the chief point of the seed, namely its existence as a potentiality rather than an actuality. Now the spinal marrow which is the seed is called a *πανσπερμία* in Plato, *Timaeus* 73 B-C, and it seems certain to me that it is this theory to which Aristotle is referring, for in the marrow the elements of all the bodies exist. There is probably a reference to the same notion in *De Gen. Animal.* 722 A 33-35 where he says that, if flesh and bone are composed of the four elements, the semen would best come from these elements if pangenesis were the right explanation. If it be objected that the theory here mentioned supposes that the female, too, contributes seed, I

Since Aristotle restricts the formal cause to the male semen and the matter to the catamenial fluid, he objects to any explanation of imperfection in the embryonic development which makes the semen the cause of this imperfection. His own explanation of monstrosities, however, according to which such phenomena result from the resistance of the matter when it is so great that the formal cause cannot control the material further than to impose upon it the generalized form of "animal," does in effect make the cause a deficiency of power in the semen. Democritus ascribed monstrosities to a kind of superfoetation in which new male sperm joined with the embryo already developing in the uterus;<sup>244</sup> he, of course, considered the semen to be a contribution of matter to the new animal, but to Aristotle such a theory amounted to making the form the cause of the imperfection and required the admission that a new "formal cause" added to matter already in process of information would increase the number of material parts. The cause must be traced to the matter; and Aristotle ascribes phenomena of this sort to the union of originally distinct embryos,<sup>245</sup> thinking that the production of a litter of separate offspring from a single emission of semen shows that, in animals which so conceive, a monster in the litter cannot be due to superimposed semen from a second coition. The uterine mole, which was considered to be an embryo the development of which had somehow been impeded,<sup>246</sup> Aristotle also explained as an arrest of development due to a deficiency of heat with the result that the matter is not informed.<sup>247</sup> Some people<sup>248</sup> had supposed the cause of

think anyone who reads *Timaeus* 91 A-D will admit that Plato could not consistently have otherwise supposed. Spinal marrow which is seed exists in both sexes, and he expressly says that both sow the unformed animals into the womb (*Timaeus* 91 D 2-3). Moreover, if this be the reference, there is no need to change *ἔρεποι* (*De Gen. Animal.* 769 A 7) to *ἔρεπα* with Platt, for Aristotle is giving the theories of "some physical philosophers and others."

<sup>244</sup> *De Gen. Animal.* 769 B 30-770 A 7. Democritus' theory seems to have been concerned only with *monstra per excessum*. The text in the few sentences devoted to Aristotle's account of the theory is sadly corrupt; the general sense, however, is clear.

<sup>245</sup> Cf. *De Gen. Animal.* 770 A 14 ff.

<sup>246</sup> Cf. Hippocrates, *γυναικείων πρῶτον*, § 71 (Littré, VIII, 148-150).

<sup>247</sup> *De Gen. Animal.* 775 B 37-776 A 8.

<sup>248</sup> They may have been Hippocratics who seem to have thought that the



uterine moles to be heat, a notion which was probably inspired by the frequent hardness of the body; but such an explanation would attribute the arrested development to the instrument which for Aristotle was the means of informing matter. He had consequently to invert this theory and to claim that hardness is due to imperfect concoction and so to insufficient heat.<sup>249</sup>

In the articulation of the embryo as in the development of any other process the first efficient cause must precede the other parts the development of which derives from it; as the heart contains the vital heat which is the instrument of the formal cause in its organization of matter, Aristotle insists that the heart or its analogue is the first part actually differentiated in the embryo<sup>250</sup> and objects to those who, like Democritus,

excessive catamenial fluid solidifies the sperm (cf. Hippocrates, *γυναικείων δεύτερον*, § 178 [Littré, VIII, 360]).

<sup>249</sup> His remarks on the temperature of cartilaginous fish and vipers are determined by the same sort of reasoning (*De Gen. Animal.* 718 B 32-719 A 2). They bear live young but first are internally oviparous; and Aristotle argues that they are internally oviparous because they have a cold nature, whereas some people deduced from the fact that they are externally viviparous the conclusion that these animals are naturally warm. The egg is not deposited externally, because it has a soft covering and so would be destroyed outside of the body; but it has a soft covering because these animals have too little heat to dry the egg-shell completely. The soft-shelled egg is a sign of imperfect development which can be due only to a deficiency. Who argued that these fish are warm in nature because they are viviparous I do not know.

<sup>250</sup> *De Gen. Animal.* 740 A 3-13. In *Parva Naturalia* 469 A 16-23 he attempts to prove that the heart is the center of sensation by the argument that animal life is defined by its capability of sensation, so that for an animal the principle of life and sensation must be the same; and the principle of life for an animal is the heart, which must, therefore, be the principle of sensation also. In the course of this argument he says that some people (i. e. Alcmaeon, Plato, some Hippocratics [*περὶ λεπῆς νόσου*, § 16, Littré, VI, 390; § 14, Littré, VI, 386-388]) have supposed the brain to be the center of sensation because most of the sense-organs are in the head. Ultimately, then, Aristotle believed the heart to be the sensorium because he believed it to be the seat of the vital heat which carries the formal cause. The brain he explains as an organ constructed to cool and temper this heat and partly on this basis argues against those who made it the sensorium and said that the head is not fleshy because fleshy parts would not let the sensations through to the brain (*De Part. Animal.* 656 A 15-27, cf. Plato, *Timaeus* 75 A-B). The brain itself, Aristotle says, cannot be a cause of sensation since it has no feeling itself; but the head is lean, because a thick covering of flesh would heat the brain and so prevent its proper func-

thought the external parts were first differentiated that such a process describes animals of stone or wood rather than living beings which have within themselves the originating principle of their whole constitution.<sup>251</sup> The formal cause in the embryo brings the parts into being from the catamenial fluid just because this material contains all the parts potentially and when the active form through the vital heat present in the heart comes into contact with the passive matter it fashions it and actualizes it according to the formula of the complete animal, which is the form as final cause. The notion that the parts are articulated and grow by the natural tendency of like to like Aristotle says would imply that each of the homogeneous parts comes to be separately from the rest.<sup>252</sup> The connection of the whole body as an individual resulting from a consecutive process with one final cause would be utterly annihilated. The instrument by which the parts are differentiated Aristotle admits is air, but not air breathed by the mother or the embryo itself.<sup>253</sup> There is necessarily air in the embryo, he thinks, because there is present moisture and warmth, the former in the passive catamenial fluid, the latter in the active vital heat, and their conjunction must result in the formation of air.<sup>254</sup> But this is a necessary result of the nature of the constituent materials; quantitative

tioning. The mistake concerning the function of the brain, he says, resulted from misapprehension of the causes for the location of most sense-organs in the head; Alcmaeon, however, based his statements about the brain on dissection, the discovery of canals (i. e. nerves) and lesions (cf. Burnet, *E.G.P.*<sup>8</sup>, p. 194).

<sup>251</sup> *De Gen. Animal.* 740 A 13-17. Cf. page 257, note 158 *supra*. The Hippocratic doctrine asserted that all the parts of the animal begin to be articulated at the same time (cf. Hippocrates, *περὶ διαίτης*, § 26 [Littré, VI, 498]).

<sup>252</sup> *De Gen. Animal.* 740 B 12-25. Cf. Hippocrates, *περὶ γυνῆς*, § 17 (Littré, VII, 496). In *De Gen. Animal.* 741 B 9-15 Aristotle tries to bring this principle of growth by the movement of like to like into agreement with his own explanation of the actualization by the efficient cause of the parts which already exist potentially in the material. When they say "like to like," he says, this must not be taken to imply locomotion of the parts but qualitative alteration by which the parts become actually what they were previously only in potency.

<sup>253</sup> *De Gen. Animal.* 741 B 37-742 A 16. Cf. Hippocrates, *περὶ γυνῆς*, § 12 (Littré, VII, 486-8): the foetus respire using the air inhaled by the mother.

<sup>254</sup> Cf. *De Generatione* 331 B 14-16.



and qualitative distinctions exist potentially before they exist actually in the development of the individual and they are actualized by the same causes. The instrument is not developed unless there is use for it, just as the eyes of young dogs, lions, and others exist only potentially at birth, for these animals are born blind. So Aristotle argues that the young developed in eggs apart from the mother cannot breathe,<sup>255</sup> while some animals that are produced as scoleces or eggs do not breathe at all,<sup>256</sup> and even those that do breathe and are articulated in the womb do not breathe until the lungs have been perfected. Consequently, the articulation of the organs prior to the lungs must also be completed before there can be any respiration. The function, the performance of which must wait upon the perfection of a specific organ, cannot be the efficient cause either of that organ or of those which precede it in development.

<sup>255</sup> In Hippocrates, *περὶ γυνῆς*, § 30 (Littré, VII, 536) the fact that the chick breathes through the shell is recognized. In *De Gen. Animal.* 740 A 35-B 2 Aristotle adduces the articulation of the chick in the egg separated from the uterus as evidence in refutation of the notion of Democritus that the embryo is retained in the womb in order that parts of the body may be fashioned conformably to the parts of the mother. Aristotle, himself, says the reason is the nourishment of the embryo. The reason here said to have been given by Democritus is inconsistent with the theory that the form of the parts is due to a struggle between male and female seeds which are themselves the parts in miniature; and Aëtius (V, 16, 1) reports that the embryo, according to Democritus, is *suckled* in the womb. Probably Democritus said that the embryo required food from the mother in order that the parts might *develop* in the same fashion as her body, not in order that they might be so formed in the first place. (With Aëtius, V, 16, 1 cf. Censorinus, *op. cit.*, VI, 3 on Diogenes and Hippo.) Aristotle, however, suspected in such a statement the hint that the female contributes *form* to the offspring; and this criticism is but a repetition of his fundamental doctrine that the formal cause in its entirety is present from the first in the male semen, the contribution of the mother being only food which is the same as the original matter (the catamenial fluid) upon which the semen impresses the form.

<sup>256</sup> Cf. page 261 ff. *supra*.

## CHAPTER FOUR

## THE SOUL AND PSYCHICAL PHENOMENA

As Aristotle's criticism of earlier biological theories reduces ultimately to the objection that in none of them was the character and relationship of the four phases of causality recognized so his treatment of previous explanations of psychical phenomena was intended to demonstrate the difficulties and absurdities which result from supposing the soul to be anything other than the formal cause of the natural body.<sup>1</sup> The two most obvious points of distinction between the animate and inanimate are motion and sensation, and these, Aristotle says, almost exhaust the psychical characteristics treated by his predecessors.<sup>2</sup> Those who centered their attention upon the soul's motivity, since they thought that only what is itself in motion is capable of moving something else, supposed that the soul must be itself in motion; this was the course of reasoning that led Democritus to say that the soul is fire of a kind and heat. This identification of "fire" and "soul" is but half true; the soul as such was obviously not the same as fire for the Atomists, since they did not recognize the existence of soul outside of the living body. The shape of the atoms, however, which constitute fire and soul they declared to be the same; and Aristotle, with his customary assumption that the characteristics of every constitutive part must be the same as those of the constituted whole, considered that to be sufficient evidence for his conclusion that the soul for the Atomists was fire.<sup>3</sup> His further account, however, shows

<sup>1</sup> Cf. the definition of soul in *De Anima* 412 B 5-6 and 412 B 10-413 A 2. Since the soul is the actuality of the body which is only potentially, whether soul and body are one or not is not a real question (cf. *De Anima* 412 B 6-9).

<sup>2</sup> *De Anima* 403 B 25-404 B 15. It later appears that the characteristic of subtility was also universally asserted.

<sup>3</sup> That Aristotle's conclusion depends upon the fact that the Atomists said that both fire and soul consisted of spherical atoms and that the Atomists themselves went no further in identifying the two than to say that the shape of the constitutive atoms of both was the same *Parva Naturalia* 472 A 3-5 (λέγει δ' ὡς ἡ ψυχὴ καὶ τὸ θερμὸν ταῦτόν τὰ πρῶτα σχήματα τῶν σφαιροειδῶν) shows. Aristotle was aided in his identification by the fact that the quality of heat was attributed to the spherical atoms, for he wrongly assumed that by this the

that the Atomists were not influenced by the notion that the soul must be warm in their conclusion that it consists of spherical atoms but, rather, convinced that the motion of the body originates in the soul, they had to construct the latter of the most mobile atoms.<sup>4</sup> These they believed were the spherical

Atomists meant to call the atom itself hot. His own doctrine of heat and cold as primary qualities then made it natural for him to think that heat was for the Atomists the essential characteristic of both soul and fire (cf. page 262, note 181 *supra*). They, however, meant only that the spherical atom by its swift motion through a complex of other atoms produced in this complex body the effect of heat, a quality which they explicitly denied to the atoms themselves (cf. Theophrastus, *De Sensibus*, 63 and 68; Aëtius, IV, 9, 8). Moreover, a single spherical atom is neither fire nor soul; the specific characteristics of both of these as of all complex bodies were considered to be merely epiphenomena of the combination of atoms (cf. the important word *σύνκρμα* in Diog. Laert., IX, 44; Aëtius, IV, 3, 5). Nemesius (quoted by Diels, *Doxographi Graeci*, p. 388 t B 8) preserves both the true account and the false conclusion of Aristotle when he says that the spherical atoms by combining produce fire and soul and concludes from this that the soul is fire. This conclusion overlooks the fact that the soul is not defined by the shape of the atoms alone but also by their position in the body (cf. Lucretius, III, 370 ff.; Brieger, *Hermes*, XXXVII [1902], pp. 72-73; Windelband-Bonhöffer, *Geschichte der Antiken Philosophie*, p. 128, n. 3, where Brieger's contention is in fact admitted although the old interpretation is still clung to with the words "aber das eigentlich Seelische ist doch schliesslich Feueratome." The correct statement would be simply that spherical atoms may in certain combinations form fire and in others soul). The course of Democritus' reasoning is more accurately reproduced in *De Anima* 405 A 8-13: soul Democritus thought to be the same as mind, motive because of the fineness and shape of the atoms which constitute it; but he said that the sphere is the most mobile of figures and so that both mind and fire consist of such atoms (Aristotle really says: both mind and fire to be spherical; i. e. he again identifies mind and fire with their minimal constitutive part). Spherical atoms were assumed for fire also in order to explain its unceasing motion and penetrativeness; the heat was explained as a sensation induced in the object penetrated.

<sup>4</sup> The passage at 404 A 1-5 is confused and almost certainly corrupt. It adds, however, nothing new save a comparison of the motes in the sunbeam to the atoms; but what the point of the comparison was meant to be is not stated. Diels (54 A 28) excises 404 A 2-4, τὰ σφαιροειδῆ . . . ὧν, including the comparison, as a gloss derived from 404 A 16 ff. If the comparison be retained and if it was used by Democritus, it must have been intended to exemplify the constant motion of all the atoms (not merely soul-atoms or fire-atoms) in all directions (cf. 404 A 19-20). Brieger's reconstitution of the text (*Hermes*, XXXVII [1902], p. 72, n. 1) proceeds on this assumption but has to leave

figures because they penetrate other things most easily and, moving themselves, impart motion to those with which they come in contact.<sup>5</sup> The Pythagorean identification of soul with the motes in the air or with that which moves these motes Aristotle believes was due to the same kind of conviction that the soul as motor of the body must itself be in motion;<sup>6</sup> and this was also the determining factor in the theory of those who said the soul is that which moves itself.<sup>7</sup> Anaxagoras, too, made the soul the cause of motion inasmuch as he made "Mind" the

a lacuna for some phrase pointing the comparison of movement (cf., however, this page, note 6 *infra*). Madvig's excision of τὰ σφαιροειδῆ . . . λέγει and ὧν gets rid of the absurd repetition but leaves the comparison without point. As the text stands δμοίως δὲ καὶ Λεύκιππος says only that Leucippus as well as Democritus made the constitutive elements of all things the sum of all the atoms (πανσπερμία).

<sup>5</sup> Here Aristotle connects the Atomistic explanation of respiration with the theory of the soul (*De Anima* 404 A 9-16). The soul-atoms impart motion to the body because they themselves are never at rest, but they are likely to be extruded by the pressure of the environment. Inhalation of more spherical atoms recruits those already in the body and helps to withstand the pressure from outside; and life depends upon the ability so to maintain the internal pressure (cf. pages 262 f. *supra*).

<sup>6</sup> The sentence at 404 A 19-20 (περὶ δὲ τούτων εἴρηται διότι συνεχῶς φαίνεται κινούμενα κἂν ἢ νηνεμία παντελής) is disregarded by Themistius and Simplicius but commented upon by Philoponus and Sophonias. Biehl suspected the authenticity of the sentence (cf. his text of *De Anima*, *apparatus criticus ad loc.*); if it is genuine, it refers not to a statement of the Pythagoreans but to Aristotle's own reconstruction of their meaning, and consequently would indicate that some such phrase as συνεχῶς κινούμενα originally stood in the comparison at 404 A 3-4. The "identification" of soul and the motes is obscure, unless it refer to an old superstition rather than a philosophical doctrine (cf. Zeller-Nestle, *op. cit.*, I, p. 561, n. 3) and in that case each speck of dust was probably considered to be a soul, so that Aristotle's ψυχὴν implies complications which did not exist. But the "other" Pythagoreans who identified the soul with the power that moves these motes, if they really existed, must have been very late, for their theory obviously implies a truly immaterial soul which is simply a motor force; such a theory, since fundamentally it has nothing to do with the motes, must have been an accommodation of the earlier superstition to the more highly developed psychical theories of later times (cf. Rathmann, *Quaestiones Pythagoreae Orphicae Empedocleae*, pp. 18-19).

<sup>7</sup> Plato and his school; cf. also *De Anima* 404 A 16-30 and the criticism of the *Timaeus* in *De Anima* 406 B 26 ff.



moving cause of the universe;<sup>8</sup> this identification of mind and soul in the doctrine of Anaxagoras, however, somewhat embarrasses Aristotle. Democritus, he feels sure, made an absolute identification of soul and mind, for he believed that the sense-perception is true and, therefore, applauded Homer for saying of Hector that "he lay having other thoughts"<sup>9</sup> when he had swooned. The course of this argument shows that the only justification for ascribing this identification to Democritus lies in the supposition that he considered all sensation to be true; and how far this supposition is justified has already been considered.<sup>10</sup> However wrongly, Aristotle still is confident that Democritus does not use the term, *νοῦς*, as a separate faculty concerned with truth but as a mere synonym for soul, a conclusion which is ultimately due to Aristotle's conviction that all distinctions for the Presocratics were distinctions of material, so that, since mind and soul both consist of the same kind of atoms,

<sup>8</sup> Aristotle's addition, *καὶ εἴ τις ἄλλος εἴρηκεν ὡς τὸ πᾶν ἐκίνησε νοῦς*, Hicks suggests may refer to Hermotimus, cf. *Metaphysics* 984 B 19-20 and page 222, note 20 *supra*.

<sup>9</sup> *κεῖτ' ἄλλοφρονέων*, cf. *Metaphysics* 1009 B 28-31 (page 80 *supra*). From Theophrastus, *De Sensibus*, 58 it is clear that Democritus did not by his interpretation of Homer mean to imply, as Aristotle says he did, that the perceptions of sense are always true, no matter what the condition of the body may be but, to the contrary, that thought and understanding depend upon an equable state of the soul-atoms in the body. *ἀλλοφρονεῖν* as opposed to *φρονεῖν* meant for him not "to think other thoughts" equally true, but to think other than normally and correctly. That even in a swoon the body has some measure of perception Democritus evidently maintained, since so long as there are some soul-atoms present there must be sensation of a feeble kind (cf. Aëtius, IV, 4, 7 and Proclus, *In Rempublicam*, II, p. 113, 6 ff., Kroll).

<sup>10</sup> Cf. pages 81-83 *supra*. So far as the material constituents of soul and mind are concerned, the two are identical; but it is clear that Democritus distinguished in some sort their functions, for the truth could be gained only by reflective criticism of the material afforded by the senses. Since mind and soul, however, are materially identical and the soul is spread throughout the body, the distinction between the two must have been found in their position; the distinction of one sense from another depends upon the organ in which the soul atoms exist and the distinction of mind from soul is due to the central organ in which the same kind of atoms is present. This central organ was more probably the brain (so Brieger, *Hermes*, XXXVII [1902], p. 73 ff.) than the heart (so Bailey, *The Greek Atomists and Epicurus*, pp. 160-161).

he overlooks the importance of their different positions and functions. Anaxagoras, on the other hand, he accuses of being obscure in this matter, for frequently he uses *νοῦς* in the sense of the final cause, that which produces the good and beautiful, and again he seems to equate it with the soul. Aristotle tends at times to find an anticipation of his own final cause in the principle of Anaxagoras,<sup>11</sup> but he is at the same time aware that this "Mind" seems also to be immanent in individual organisms.<sup>12</sup> If, however, the "Mind" of Anaxagoras be present in individual living beings of all kinds,<sup>13</sup> Aristotle argues that it must signify *ψυχή*, i. e. the vital principle, for experience shows that mind in the sense of practical intelligence is not present in all animals or even in all men.

So much for those who, according to Aristotle, concerned chiefly with the problem of the motion of living beings conceived the soul as preëminently motive; those, however, who gave their attention to the soul as cognitive and perceptive identified it with their first principles whether these were one or many. Of this tendency Aristotle cites Empedocles as an example saying that he made the soul consist of all the elements and made each one of these elements soul. His evidence is the statement of Empedocles that "we see earth by means of earth, water by water, air by air, fire by fire, love by love, and strife by means of baneful strife."<sup>14</sup> That each of the elements is itself soul is a deduction of Aristotle's based merely upon this quotation as is the conclusion that all the elements together constitute the soul; but the attempt of Empedocles is to explain sensation by a thoroughly materialistic mechanism in which there

<sup>11</sup> Cf. pages 222; 222, note 21; 223, note 26.

<sup>12</sup> Cf. *Metaphysics* 984 B 15-18 and page 180, note 154.

<sup>13</sup> In *fragment* 12 Anaxagoras says *καὶ ὅσα γε ψυχὴν ἔχει καὶ μείζω καὶ ἐλάσσω πάντων νοῦς κρατεῖ* which Aristotle evidently interprets to mean that *νοῦς* is present in each and every *ἐμψυχον*. Cf. [Aristotle], *De Plantis* 815 B 16-18: *ὁ δὲ Ἀναξαγόρας καὶ ὁ Δημόκριτος καὶ ὁ Ἐμπεδοκλῆς καὶ νοῦν καὶ γινώσκιν εἶπον ἔχειν τὰ φυτά*. In *De Anima* 429 A 19, however, he interprets *κρατεῖν* in this context by *γνωρίζειν*.

<sup>14</sup> Empedocles, *fragment* 109.



is no hint of soul in any sense.<sup>15</sup> Aristotle later<sup>16</sup> indicates that the words of Empedocles did not even imply that the material

<sup>15</sup> Cf. Zeller-Nestle, *op. cit.*, I, p. 961, n. 1; p. 996, n. 1. In the *περὶ φύσεως* there is no mention of *ψυχή* and in the *καθαρμοί* the souls play no part in what Aristotle would call the psychical activities. There has been much speculation concerning the relation of Empedocles' mechanistic physics and his "mysticism" in the *καθαρμοί*. This "enigma" Souilhé has recently attempted to banish by asserting that the *δαίμονες* of the *καθαρμοί* as well as the "long-lived gods" of the *περὶ φύσεως* are combinations of elements and that the "reincarnation" is merely the recombination of the same elements ("L'énigme d'Empédocle" in *Archives de Philosophie*, IX, pp. 337 ff.). He has to admit, however, that there is "une certaine permanence de la conscience sous les différentes transformations," but he tries to explain it by saying that "une conscience sourde, comme endormie, de tout le passé reste inhérente aux éléments éternels dont les êtres ne sont que des combinaisons"; and again, "le 'je' dont il se sert pour raconter les vicissitudes de sa vie antérieure n'a pas un sens métaphysique et n'indique pas un principe permanent et substantiel." But this theory escapes an individual soul only by positing what amounts to a psychical faculty of self-consciousness in the elements; and the opposition between the *δαίμονες* and matter is sharp to the point of violence in *fragment* 115 (cf. line 12: *ἄλλος δ' ἐξ ἄλλου δέχεται, στυγέουσι δὲ πάντες*) where the preservation of individuality in the metempsychosis is clear (cf. also *fragment* 126 and Rathmann, *op. cit.*, p. 102). Nestle rightly insists upon the opposition of matter and soul in Empedocles' system (*Philologus*, LXV [1906], pp. 545-557), although he attaches the soul in the body too closely to the body itself when he intimates that the soul uses the bodily organs as instruments for perception and cognition (*ibid.*, p. 550). Empedocles was striving to reduce such processes to thorough mechanism; the soul stands apart from them as consciousness, and its understanding is gained not by cognition but by intuitive faith (as Nestle himself admits, *ibid.*, pp. 547-8). An exact parallel to this theory which relegates most of the functions commonly called psychical to the mechanism of the body and still posits individual souls passing through organic (and even inorganic) bodies in a transmutatory system is the Sāṅkhya philosophy of India, according to which, if all bodies were at once abandoned by the souls that are "fettered" to them, the bodily processes including sensation and cognition would still continue, the only difference being that there would be no consciousness. (W. Kranz in *Hermes*, LXX [1935], pp. 111-119 now argues that the *καθαρμοί* were written under Orphic influence, that they are quoted in the *περὶ φύσεως* which "naturalizes" the religiosity of Empedocles' earlier Orphic beliefs. The four "elements," he thinks, form a holy *τετρακτύς* and derive from Orphic poems. But that the essential problem is still untouched by this analysis appears from Kranz's own words [*ibid.*, p. 118]: "Der *λατρός θεολόγος* der Katharmoi ist in der Physik zum *λατρός φυσικός* geworden—und bleibt trotzdem ein *θεολόγος*.")

<sup>16</sup> *De Anima* 408 A 18-29 where he tries to find a similarity between Empedocles' theory and that of the soul as an harmony.

elements are soul or constitute it and that he is at a loss to discover just what soul is in that system; but in the present passage he is intent upon proving that his predecessors erred by making the soul matter instead of form, and so he neglects the real difficulties of Empedocles' theory to make it fit into his classification.<sup>17</sup>

Whether they were chiefly impressed by the perceptive or by the motive power of the soul and whether they considered the principles one or many, material or immaterial or both, all his predecessors, he says, give an account of the soul which corresponds with their theories concerning the principles of the universe, for they reasonably assume that what is naturally motive is one of these principles.<sup>18</sup> In short, Aristotle now contends that even those who considered the soul chiefly as the cause of motion derived it from the principles which in their systems of the universe were analogous to those in the systems where the soul was identified with one or more elements for the purpose of explaining its perceptive faculty and that in these latter theories the motive power of the soul was accounted for by the motion of the element which constituted it. In this fashion he manages to group all earlier doctrines of the soul together as alike in failing to recognize the soul as formal cause. This line of reasoning he says<sup>19</sup> impelled some to think the soul is fire, for fire is the most subtle and least corporeal of the elements<sup>20</sup> and in addition is primarily mobile and motive. Democritus came to the same conclusion but by means of a more elegant proof;<sup>21</sup> and Anaxagoras,<sup>22</sup> although Aristotle has already said

<sup>17</sup> He then tries (*De Anima* 404 B 16-27) to show that Plato also constructed the soul from the "elements" and (404 B 27-30) that Xenocrates' theory combined this material moment with that of the motor.

<sup>18</sup> *De Anima* 404 B 30-405 A 5. Cf. Rodier, *Traité de l'Âme*, II, pp. 62-63.

<sup>19</sup> *De Anima* 405 A 5-7. This refers to Heraclitus and the Heracliteans, not (as Bailey says, *op. cit.*, p. 156) to Democritus.

<sup>20</sup> Cf. pages 13, 14-16, 228 f. *supra*. The phrase *μάλιστα δσώματων* means only "least dense," "most nearly incorporeal of all bodies."

<sup>21</sup> *De Anima* 405 A 8-13. The conclusion of the Atomists according to Aristotle was that the soul is fire (line 13, cf. page 289, note 3 *supra*). The two characteristics of the soul which Democritus explained to the same effect but with more elegance than the Heracliteans (*διὰ τί τούτων ἑκάτερον*) were 1)



that he seems to have meant something different by the terms *νοῦς* and *ψυχή*<sup>23</sup> (and although he obviously cannot be said to have identified *νοῦς* with the material cause), uses both as a single essential nature except that he treats *νοῦς* specifically as the first principle. This Aristotle concludes from the fact that of all things only *νοῦς* is called simple, unmixed, and pure.<sup>24</sup> The point of the doctrine which relates it to all the rest, however, is that Anaxagoras by saying that the universe is set in motion by *νοῦς* refers the cognitive and motive faculties to the same principle and to one which is also a cosmological principle. This characteristic Aristotle then seeks to identify in as many of the earlier theories as possible.<sup>25</sup> If it is true, he says, that Thales attributed a soul to the magnet because it attracts iron, it is clear that he too understood the soul to be a cause of motion.<sup>26</sup> Dio-

its fiery nature, i. e. its subtility (for it is the subtility which makes it fire), and 2) its motivity. The greater elegance consists in the fact that these two characteristics derive from the shape and size of the constituent atoms of both fire and soul, so that fire and soul are identified by the identity of their constitutive parts. (Simplicius, *De Anima*, 31, 8 ff., and Zeller, Zeller-Nestle, *op. cit.*, I, 1115, n. 2, took *τούτων* = *τοῦ κινητικοῦ καὶ γνωριστικοῦ*; but apart from the fact that nothing has been said of cognition, Aristotle's point is that the Atomists, like the Heracliteans, connected the motive power of the soul with the nature of the material principle that constitutes it. For *τούτων* to refer to *κινεῖν καὶ κινεῖσθαι* [the interpretation of Themistius, Philoponus, and Rodier] would miss the point in the same way. Concerning Aristotle's statement here that for Democritus soul and mind were identical see page 292, note 10 *supra*.)

<sup>22</sup> *De Anima* 405 A 13-19.

<sup>23</sup> Cf. pages 291-293 *supra*.

<sup>24</sup> Cf. Anaxagoras, *fragment* 12. For Aristotle's various interpretations of the *νοῦς* of Anaxagoras cf. page 172, note 122 *supra*.

<sup>25</sup> *De Anima* 405 A 19-B 10.

<sup>26</sup> Aristotle evidently interprets this tradition to mean that everything has soul and connects it with the saying he attributes to him (*De Anima* 411 A 8), *πάντα πλήρη θεῶν*, for he says the basis of this statement may have been the belief that the whole universe is imbued with soul. (Diogenes Laertius, I, 24 says that Aristotle and Hippias concluded from the statement about the magnet that he thought inanimate things have souls.) Burnet (*E.G.P.*<sup>8</sup>, p. 50) remarks that to say the magnet is alive "is to imply, if anything, that other things are not." Whether Thales said that "all things are full of gods" and, if he did, what he meant by it is not to be discovered; the apophthegm was referred to by Plato (*Laws* 899 B) and Aristotle plays upon it in *De Gen. Animal.* 762 A 18-21 where he says that plants and animals grow in earth and water because

genes<sup>27</sup> and some others,<sup>28</sup> again, made the soul air; Aristotle supposes that this substance was chosen because it was thought to be the most subtile body and so a principle of the rest, so that, as the material constituent of all other things, it would have cognition of them and, as the most subtile, would be the principle of motivity. Heraclitus, in like manner, made his material principle soul, for he identifies it with the warm vapor<sup>29</sup>

in earth there is water, in water *πνεῦμα*, and in all *πνεῦμα* vital heat, so that in a way *πάντα ψυχῆς εἶναι πλήρη*. The story he tells to warn his students from "squeamishness" in biological studies attributes much the same sentiment to Heraclitus who told friends who hesitated to come into the kitchen where he was warming himself to "come cheerily in, for there are gods here too." (*De Part. Animal.* 645 A 15-23.) The saying may, then, be one of those that were indiscriminately ascribed to the "sages" and may, as Burnet says, mean only that nothing is more divine than anything else. But the belief that the attraction exercised by the magnet is due to the presence of soul in the magnet itself implies an element that Aristotle does not notice, for the body that moves is the iron yet the moving cause is presumably not in it but in something distant from it. "Soul," here, seems to be invoked to explain not ordinary movement but "action at a distance" (cf. Frankl, *Archiv für Geschichte der Philosophie*, XXXV [1923], p. 155 ff.).

<sup>27</sup> Diogenes of Apollonia, *fragments* 4 and 5.

<sup>28</sup> Cf. Anaximenes, *fragment* 2; Archelaus (cf. Aëtius, I, 7, 14; but this does not mean that the air as such is soul, cf. Zeller-Nestle, *op. cit.*, I, 1273) represented the original Anaxagorean "mixture" as air and considered the *νοῦς* to have been connected with this "mixture" from the first (cf. Aëtius, I, 3, 6 and Theophrastus, *Physic. Opin.*, *frag.* 4 [Diels, *Doxographi Graeci*, pp. 479-80]; Hippolytus, *Refut.*, I, 9, 1). From later confusion of this doctrine evidently arose the report (Plutarch, *De Placitis*, IV, 3, 2) *οἱ δ' ἀπὸ Ἀναξαγόρου ἀεροειδῆ* (scil. *τὴν ψυχὴν*) *ἐλεγόν τε καὶ σῶμα*; and hence it was but a step to the false ascription of the same doctrine to Anaxagoras himself (Stobaeus, I, 49, 1 [Wachsmuth, I, p. 319, 10]). The same notion of the soul was attributed to Anaximander by Theodoretus (*Graec. Affect. Cur.*, V, 18) on which see Neuhaeuser, *Anaximander Milesius*, p. 425.

<sup>29</sup> Cf. Heraclitus, *fragments* 12 (*καὶ ψυχὰς δὲ ἀπὸ τῶν ὑγρῶν ἀποθυμῶνται*) and 36. In the fragments of Heraclitus as they stand I can see no evidence for a belief in the immortality of the soul. On this vexed question see Rathmann, *op. cit.*, 88-90 on the one side, Nestle, *Philologus*, LXIV (1905), pp. 367 ff. on the other, also the notes in Zeller-Nestle, *op. cit.*, I, 882-898. (The curious theories of O. Gigon [*Untersuchungen zu Heraklit*, Leipzig, 1935, pp. 115-134] are not convincing.) The soul is immortal only in the sense that the universal flux of which it is one phase is without beginning and without end; and, if the metaphorical language of Heraclitus is given its due weight and



of which he constructed all other things. This principle also was thought to be most subtle and in constant flux, for that which is in motion can be known only by something in motion, and Heraclitus like most philosophers thought the world of existence to be in motion. That the soul as cognitive or sensitive must be in motion because the objects of sensation are in motion was, of course, not the reason for Heraclitus' identification of the soul with fire; the soul must have been a flux for him simply because everything was, he thought, a flux. Aristotle here attributes to him a course of reasoning which will justify his own assertion that the soul was identified with the primary constituent of things in order that, on the principle of "like to like," it might know them all.<sup>30</sup> Similarly there could have been no epistemological or psychological basis for the designation of the soul as fire, for to Heraclitus all things were fundamentally identity in difference, fire being only a name for the "purest" or "highest" phase of the incessant process; but Aristotle, intent upon proving that for these early thinkers the soul was regarded only in the aspect of material cause, insists that Heraclitus identified it with the material constituent of the universe even though the words of the author force him to call that constituent here "vapor" rather than the "fire" which he usually gives as Heraclitus' "element."<sup>31</sup>

the fact that the soul may leave the body as fire or pass into water at death is remembered, such fragments as 24, 25, 63 present no difficulty.

<sup>30</sup> Cf. *De Anima* 405 A 23-24 (ἡ μὲν πρῶτον ἐστὶ καὶ ἐκ τούτου τὰ λοιπά, γινώσκειν); 404 B 17-18 (γινώσκεισθαι γὰρ τῷ ὁμοίῳ τὸ ὅμοιον, τὰ δὲ πράγματα ἐκ τῶν ἀρχῶν εἶναι). Rodier, *Traité de l'Âme*, II, 69 refers to Theophrastus, *De Sensibus*, 1 for the notion that Heraclitus believed sensation to be due to the interaction of opposites; but this statement was due to the mistaken interpretation of Aristotelian ἀλλοίωσις into the system of Heraclitus (cf. Heidel, "Qualitative Change etc." in *Archiv für Geschichte der Philosophie*, XIX [1906], pp. 357-359).

<sup>31</sup> "ἀναθυμίασις," says Zeller (Zeller-Nestle, *op. cit.*, I, 883, n. 1), "nur dasselbe bedeutet was sonst πῦρ genannt wird" and refers to this passage as evidence. To be sure ἀναθυμίασις is a kind of fire, but so is everything else (Heraclitus, *fragment* 30), and the soul is still soul in varying degrees of "purity" (*fragments* 117, 118 [αὐτὴ ψυχὴ σοφωτάτη καὶ ἀπλοτή]) nor can that be called the ἀρχή in Aristotle's sense which itself derives from something else (*fragments* 12 and 36). The truth is that Heraclitus recognized no ἀρχή

The concept of the soul as ever-moving suggested to Aristotle the theory of Alcmaeon which he next mentions. Alcmaeon had said that the soul is immortal because it is like immortal beings in being ever in motion; this attribute of immortal things he proved by reference to the unending and continuous motion of the heavenly bodies and the heaven itself. There is no indication, however, that Alcmaeon identified the soul with a cosmological principle nor does Aristotle seek to prove that he did; consequently, the reference to him has no bearing upon the topic of this doxography, and it must be that Aristotle mentions him only parenthetically as another thinker who made motion a prime characteristic of the soul.<sup>32</sup>

Hippo<sup>33</sup> is then mentioned as one of those more crude thinkers who made the soul water, persuaded, Aristotle thinks, by the fact that the seed of all animals is moist. This, at any rate, was evidently the argument of Hippo who refuted those who said the soul is blood<sup>34</sup> by pointing out that the seed is the

in the sense which Aristotle gives that word. On the soul as ἀναθυμίασις cf. Capelle, *Hermes*, LIX (1924), pp. 121-123.

<sup>32</sup> Aristotle himself implies that he has no exact knowledge of what Alcmaeon thought the soul to be (παραπλησίως δὲ τούτοις καὶ Ἀλκμαίων ἔοικεν ὑπολαβεῖν περὶ ψυχῆς. φησὶ γὰρ κτλ.). The influence of Alcmaeon on Plato—and on Aristotle himself—accounts for the mention of him in a discussion where he is really out of place (cf. Hirzel, *Hermes*, XI [1876], pp. 245-246). Although Alcmaeon gave this reason for the immortality of the soul, he explained death by a statement which seems at first to controvert it, for he said that men die because "they cannot join the beginning to the end" ([Aristotle], *Problem.* 916 A 33-35). The second statement, however, clearly refers to bodily development (cf. Gomperz, *Griechische Denker*<sup>3</sup>, I, 122; Burnet's reference to the "circles in the soul," *E.G.P.*<sup>3</sup>, p. 195 makes nonsense of the statement that the soul is immortal), and implies that Alcmaeon distinguished between soul and the material body as he surely did between thought and sensation (cf. Hirzel, *loc. cit.*, pp. 242-245; even though Alcmaeon himself may not have used ἀισθάνεσθαι, Theophrastus, *De Sensibus*, 25 shows that he distinguished between thought and the activities of eye and ear; cf. Schottländer, *Hermes*, LXII [1927], pp. 438 ff.).

<sup>33</sup> In Aëtius, V, 7, 3 (cf. Censorinus, *De Die Natali*, VI, 4-5) he is called Hipponax. For an account of his theory cf. Anonymi Londin., *Ex Arist. Iatr. Menon. Eclogae*, XI, 22 ff. (26 A 11, Diels, *Fragmente der Vorsokratiker*). On the present argument cf. page 218, note 3 *supra*.

<sup>34</sup> Hippo may have been directing his argument against the remarks of Empedocles preserved to us in *fragment* 105. It is noteworthy that Aristotle himself



original soul<sup>35</sup> and is not blood. Others, like Critias, identified the soul with blood because they thought sensation to be the specific characteristic of the soul and supposed sensation to be due to the nature of blood.

This enumeration, Aristotle concludes, shows that every element except earth has found a supporter in the contest to be identified with the soul, earth having been championed only in so far as some have said the soul is identical with all the elements or derived from all of them.<sup>36</sup> Motion, sensation, subtilty are the determinants of soul in all the theories and each of these characteristics refers to the ultimate principles;<sup>37</sup> therefore, those who define the soul as cognitive—all save one<sup>38</sup>—make it an element or construct it of the elements (i. e. if they recognize more than one material principle). This they do, Aristotle says, because they say that like is known by like, so that, since the soul knows everything, they must construct it of all the constitutive principles. If they recognize only one such principle, as fire or air, the soul is identified with that one; if they posit a multiplicity of principles, the soul, too, must be constructed of all of them. Anaxagoras, however, cannot be fitted into this explanation; he alone, Aristotle says,<sup>39</sup> declared mind to be impassive and to have nothing in common with anything else. If it has this nature, however, Aristotle objects, it is not clear how or why it has knowledge of anything and Anaxa-

does not say that Empedocles identified the soul with blood or even with the blood about the heart, for, although he wrongly thought Empedocles "made each of the elements soul and soul of all the elements" (cf. page 294, note 15 *supra*), he was evidently aware that the blood has "most sensation" only because it is the most perfect mixture of the four roots (cf. Theophrastus, *De Sensibus*, 10).

<sup>35</sup> Cf. Hippolytus, *Refut.*, I, 16.

<sup>36</sup> Cf. *De Anima* 404 B 11-12: 'Εμπεδοκλῆς μὲν ἐκ τῶν στοιχείων πάντων εἶναι δὲ καὶ ἕκαστον ψυχὴν τούτων. Cf. the same statement about the choice of a single material principle in *Metaphysics* 989 A 6-10 (page 229 *supra*). The omission of any reference to Anaximander in this résumé is noteworthy; obviously whatever his doctrine of soul was (if, indeed, he had any) it would have been almost hopeless to seek to identify it with τὸ ἀπειρον.

<sup>37</sup> *De Anima* 405 B 10-19.

<sup>38</sup> I. e. Anaxagoras.

<sup>39</sup> *De Anima* 405 B 19-23.

goras himself did not explain this difficulty. The adjective, "impassive," is, however, an interpretation of Aristotle's; Anaxagoras did indeed say that the *voûs* is unmixed, has no part in anything else, and Aristotle interpreting all *interaction* as *alteration* consequently supposed that Anaxagoras meant that the *voûs* could not be acted upon by other things in the sense of being altered. So far the interpretation is strictly right though anachronistic, since Anaxagoras had no notion of qualitative alteration at all. He seems to have thought that, since the action of *voûs* was to be unique, its nature had to be unique, that it could not completely dominate all else if it were to the slightest degree like some part of what it dominates;<sup>40</sup> in solving this difficulty as he did he, doubtless, fell into the contradiction of having action without interaction, a contradiction which oppresses Aristotle's God also. But Aristotle's interpretation of the "unmixed" nature of *voûs* as impassivity introduces into the system the completely alien notion of qualitative change.<sup>41</sup> In a similar fashion he hints that sensation and knowledge were for all the Presocratics a species of alteration when he designates the elements as "contraries"<sup>42</sup> and says that those who introduce contraries into their principles construct the soul of contraries,<sup>43</sup> those who take one of the contraries, e. g. hot or cold, as their constitutive principle also make the soul one of a pair of contraries.<sup>44</sup> Since "contrary" for Aristotle always sug-

<sup>40</sup> Cf. Anaxagoras, *fragment* 12. If *voûs* were mixed ever so slightly with some one ingredient of the world, it would contain all things. In that case all the world would act upon *voûs* as well as be acted upon by it, for like acts upon like (Rodier, *Traité de l'Ame*, II, p. 72, gives a false explanation because he accepts the mistaken report of Theophrastus [*De Sensibus*, 27] that for Anaxagoras interaction took place between dissimilars; this notion arose from the Aristotelian misinterpretation of Anaxagoras' "mixture" and the confusion of interaction with the principle of psychological contrast. Cf. Heidel, "Qualitative Change etc.," *Archiv für Geschichte der Philosophie*, XIX [1906], pp. 358-9, 369-71; also page 91, note 387 *supra*).

<sup>41</sup> It also enables him to reinterpret the *voûs* as his own "unmoved mover" (cf. *Physics* 256 B 20-27 and page 172, note 122 *supra*; page 305, note 57 *infra*).

<sup>42</sup> *De Anima* 405 B 23-26.

<sup>43</sup> Empedocles, for example, since his four roots contain according to Aristotle's system the contraries, hot-cold, dry-moist.

<sup>44</sup> The "etymologies" that Aristotle cites (*De Anima* 405 B 26-29) he

gests qualitative change, it is apparent that he is with this interretation preparing the way for a refutation of all such theories from the point of view of alteration.

All the previous theories regarded the soul as motive but assumed that any motor had itself to be in motion; Aristotle also considers the soul to be a motive principle, but he has argued that such a principle need not itself be moved<sup>45</sup> and now proceeds to show that the soul as movent cannot itself be in motion at all, except accidentally.<sup>46</sup> All the species of motion, locomotion, alteration, growth and decay, occur in space, so that, if motion is a natural attribute of the soul, the soul will move in space and so there will be a natural place for the soul. Consequently, there will be both natural and constrained motion and rest of the soul, though what these can be is hard to say. And, again, if its natural motion is upward, the soul will be fire; if downward, earth;<sup>47</sup> and similarly, if it have intermediate motions, it will be water or air. Next Aristotle argues that if the soul moves the body by moving itself, the nature of the motions of both is presumably the same; but the body is moved spatially, so that the soul must move spatially within the body<sup>48</sup> and so ought to be able to leave the body and return to it. But that implies the possibility of the resurrection of dead bodies.

To argue that the soul is mobile because it can be moved accidentally is to surrender the position that it is by its own nature mobile, for that which is self-moved can be moved by something else only incidentally, just as what is in itself a good

believes support his statement that it was as one of a pair of contraries (e. g. hot-cold) that these philosophers viewed the soul. Some say that the word ζῆν itself is evidence that the soul is "that which is hot" (ζεῖν = "boil"); others contend that ψυχή was the name given to the soul because of respiration and cooling and that this is evidence that the soul is "that which is cold." The second etymology occurs in Plato, *Cratylus* 399 D-E. Philoponus (*De Anima*, 92, 3 ff.) attributes the second to Hippo, the first to Heraclitus; but that is evidently only his own deduction. The *Cratylus*, however, shows that such etymologizing was a favorite sport of the Heracliteans.

<sup>45</sup> Cf. page 168, note 110 *supra*.

<sup>46</sup> *De Anima* 405 B 31-406 B 15.

<sup>47</sup> For whatever naturally moves upward is fire, etc. Cf. *Topics* 130 A 10-14, 137 B 36-138 A 2.

<sup>48</sup> Cf. Shorey, *American Journal of Philology*, XXII (1901), pp. 152-3.

can be only incidentally a means to an end. But, if the soul moves, one would grant that it is moved by sensible objects—not incidentally but as soul, so that its most essential movements are movements induced by something other than itself.

Finally, if the soul moves itself, it is also moved; but every motion is alteration of the moved quâ moved, a displacement of the moved in so far as it is moved.<sup>49</sup> It follows, then, that, if the motion of the soul is not accidental, it will in moving be displaced from its own essential nature.

Some like Democritus had, indeed, asserted just the proposition which Aristotle deduced as an absurdity, namely that the soul moves the body just as it moves itself,<sup>50</sup> that is that the soul moving itself spatially within the body produces the locomotion of the body, a notion which Aristotle compares with the idea of Philipp, the comic poet, who said that Daedalus made a wooden Aphrodite which moved by virtue of the quicksilver he had poured into the statue. This is just what the theory of Democritus amounts to, according to which the spherical atoms, which are in motion because it is their nature never to be at rest, draw the body along and move it with their motion. To this theory Aristotle responds by asking whether these same moving atoms also make the body come to rest. But to all these mechanical explanations of bodily motion he objects that the soul moves the body by thought and choice, which is again the objection that all these theories take no account of final causes. It is the soul as form, and form as final cause, that moves the body, its material.<sup>51</sup>

The notion that the soul is composed of the elementary constituents of the universe arose from the hypothesis that like is known by like, so that these early thinkers supposed that the soul's knowledge and sensation of each and every thing could

<sup>49</sup> Cf. *Physics* 222 B 16: μεταβολή δὲ πᾶσα φύσει ἐκστατικόν, *Physics* 261 A 20-21: ἡκιστα τῆς οὐσίας ἐξίσταται τὸ κινούμενον τῶν κινήσεων ἐν τῷ φέρεσθαι. This depends upon the definition of motion as the actualization of the potential quâ potential (*Physics* 201 A 9-B 15, cf. pages 164 f. *supra*).

<sup>50</sup> *De Anima* 406 B 15-25, cf. 406 A 30-B 3.

<sup>51</sup> Cf. *De Motu Animal.* 700 B 23-701 A 6, *Metaphysics* 1072 A 24-B 4, Rodier, *Traité de l'Ame*, II, pp. 88-90.



be possible only if in some sort the soul were considered to *be* the things it knows and perceives. Upon this reconstruction, then, Aristotle criticizes all the theories that, according to his account, identified the soul with one or more of the constitutive material principles.<sup>52</sup> Granting for the sake of argument that the soul is itself the constitutive material of the objects of sensation and knowledge and that on the principle of "like to like" it perceives and knows all the elements of which things are composed, he objects that there remains an infinite number of things besides these elements, namely all the combinations and variations of them which on the principle stated the soul cannot perceive or know as such. The composite thing is not the element or elements at random but the elements combined according to a definite formula as Empedocles himself admits in the case of bone,<sup>53</sup> so that there will be nothing to know the composite objects unless these formulae are also present in the soul, not only such things as stone and man but also such abstract qualities as good and not-good. The difficulty is then presented from the point of view of the categories. The world of Being includes substances, quantities, qualities, and so on; and the soul in order to perceive these various categories ought to consist of all of them.<sup>54</sup> If, however, it is constructed of the elements, this cannot be, for there is no element common to all the categories;<sup>55</sup> and, if it consists of the elements of substances alone, it will not be able to apprehend the other categories. If one should attempt to circumvent this difficulty by supposing

<sup>52</sup> *De Anima* 409 B 23-411 A 24.

<sup>53</sup> He quotes the first three lines of Empedocles, *fragment* 96, a passage which he interprets as an indication that Empedocles vaguely recognized the formal cause (cf. *Metaphysics* 993 A 17-24 and page 233, note 75 *supra*).

<sup>54</sup> The mention of stone, man (i. e. particular substances), good, not-good (i. e. qualities), and "the rest" (410 A 11-13) suggested to Aristotle the argument that the soul, in order to perceive the categories must, on the assumed theory, be all of them which is, on his own theory, impossible. The argument is not an anticipation of a possible variation in the theory (Trendelenburg, *De Anima* [1877], p. 233) according to which the soul would consist of logical principles; it is a *reductio ad absurdum* of the original theory by means of Aristotle's doctrine that the elements themselves are not final but are informations by certain qualities of the primary potential substrate.

<sup>55</sup> Cf. *Metaphysics* 1024 B 9-16, 1065 B 5-9, 1070 A 33-B 21.

that the soul is constructed of elements which are the specific principles of the various categories, the soul will be at once quantity, quality, and substance; but the soul is a substance and not a quantity and a substance cannot be derived from the elements of quantity.<sup>56</sup>

The basis of this construction of the soul from the elements, the theory that sensation occurs only when the sensitive subject and sensible object are similar, is itself inconsistent, Aristotle asserts, with the general axiom that only dissimilars can react, that similar things are impassive with respect to each other. To have sensation is to be affected and to be set in motion, according to the hypothesis of these earlier thinkers; so is the process of intellection. In that case, Aristotle says, the process calls for dissimilarity of subject and object on the basis of their own theory of interaction. Here again Aristotle depends upon his misinterpretation of the Presocratic notion of interaction; he took it to be alteration and so supposed that it involved contraries which for him meant contrary qualities. On this basis, then, he read into the action-passion of earlier systems his own theory of qualitative change which occurs only between contraries and supposed that the psychological mechanism of the Presocratics was based upon an hypothesis the very opposite of that on which they built up their theories of physical change.<sup>57</sup> Knowledge and sensation considered as alteration

<sup>56</sup> Aristotle himself holds that the soul is substantial essence and, although his predecessors made no such distinction, he contends that their remarks about the soul show that they, too, must have thought it to be substance. But if one derives it from elements of quantity, quality, relation, etc., it must be itself a quantity, quality, etc.; yet what is quantity cannot be substance, etc. (cf. *Metaphysics* 1029 A 7-33). Hence the soul cannot be the various categories by reason of derivation from the principles of those categories; and, on the theory of perception and knowledge here assumed, it could not apprehend those categories.

<sup>57</sup> In *De Generatione* 323 B 1-15 he says that only Democritus thought interaction takes place between similars, while all the rest thought τὰ ἀνόμοια καὶ τὰ διάφορα ποιεῖν καὶ πάσχειν ἀλλήλα πέφυκεν. This interpretation was due to his reading his own conception of contraries into earlier thought, and the mere fact that no Presocratic approximated a conception of qualitative alteration proves it to be false. The common assertion of the element of "contrast" in sensation evidently seemed to Aristotle to give support to his interpretation;



may indeed present difficulties to Aristotle's own theory,<sup>58</sup> but the application of these difficulties to earlier systems, which recognized no qualitative alteration, is beside the point.

The preëminent exponent of the theory under consideration is for Aristotle Empedocles, and certain of the objections directed against the mechanism which explains knowledge by means of corporeal elements are particularly pointed against his version of it. Those parts of the animal body which consist simply of earth, such as bones, tendons, hair,<sup>59</sup> have no perception at all, though they ought, on the theory, to perceive similar objects. Moreover, each elementary principle would have more ignorance than understanding, since each would know one thing only and be ignorant of all the rest.<sup>60</sup> These objections are obviously directed specifically against Empedocles; those who posited a single principle gave it alone in its state as vital principle the faculty of sensation and made it sensitive of all things inasmuch as all were derived from it. As

cf. *Nicomachean Ethics* 1154 B 7-9 where, having said that to many people the neutral state seems positively painful, he remarks that the physical philosophers say that the living creature is always suffering, for seeing and hearing are really painful but do not seem to be so because the subject is accustomed to the pain. In mentioning this sentiment as that of Anaxagoras, Theophrastus (*De Sensibus*, 29) falsely assumes that it follows from his hypothesis of "interaction of dissimilars." Aristotle plainly implies that it was a common opinion, and Theophrastus himself (*ibid.*, 9 and 42) testifies that Empedocles and Diogenes made use of the same notion of contrasting states in their theories of sensation as did Anaxagoras, while Aristotle mentions it as used by the Pythagoreans (*De Caelo* 290 B 24-29). Cf. page 301, note 40 *supra*; page 318, note 107 *infra*.

<sup>58</sup> See *De Anima* 429 B 22-430 A 9 where Aristotle attempts to reconcile his theories of alteration and intellection and incidentally to correct Anaxagoras whose *voûs* he has identified with his own concept of mind by means of the adjective *ἀπαθής* (cf. page 172, note 122 *supra*).

<sup>59</sup> Cf. *Meteorology* 389 A 11-13.

<sup>60</sup> In *De Anima* 411 A 2-7 he argues, on the other hand, that, if the soul as cognitive must consist of the elements, it need not be constructed of all of them, for one of a pair of contraries discerns both itself and its contrary. This is merely a dialectical argument, for the one contrary is only a test of the other's not being itself or like itself, that is the discernment by contraries is limited to those cases where the two are related as state and privation (cf. Simplicius, *De Anima*, 72, 24-73, 1 and Aristotle, *Metaphysics* 1055 B 11-29).

for Empedocles, he probably would have insisted that hair and bones are capable of sensation, though only in a dull fashion;<sup>61</sup> and the second objection is not particularly damaging, for the sensation of the totality of objects is explicitly assigned to that organ in which all the elemental principles reside together.<sup>62</sup> The same sort of criticism is Aristotle's complaint that for Empedocles the god is the most ignorant of beings. God here means the *Sphere*; it contains no portion of "Strife" of which it must consequently be ignorant whereas all mortal things know all the elements since they are constructed of all.<sup>63</sup>

Since everything is either an element or derived from an element or elements and as such must know something or everything, Aristotle says that there is no clear reason why on this theory everything should not have a soul. This would certainly be cogent against such monists as identified soul with their material element; but it seems that they admitted that everything had or was soul in a sense. The psychical functions differed, however, with the various physical states of this element, at least for Heraclitus<sup>64</sup> and Diogenes;<sup>65</sup> Empedocles, if he admitted varying degrees of sensation in all objects animate as well as inanimate, is not open to the present criticism. Moreover, since for him sensation is simply mechanical and soul is not to be confused with sensitive or cognitive faculty,<sup>66</sup> the fact that stone has a dull sensation of stone or earth does not imply that a soul is present in it.

Aristotle's next objection, however, is justified against Empe-

<sup>61</sup> Cf. Empedocles, *fragments* 110, 10; 109; 103.

<sup>62</sup> Cf. Empedocles, *fragment* 105 and Theophrastus, *De Sensibus*, 10.

<sup>63</sup> On this criticism cf. page 232, note 64 *supra*. *ἐκ πάντων γὰρ ἕκαστον* including "Strife" and "Love" as constituent elements is simply a misinterpretation of *ἐκ τούτων γὰρ πάντα* (*fragment* 21, 9 and *fragment* 107).

<sup>64</sup> Cf. page 298, note 31 *supra*. Earth and fire are fundamentally the same, but as different phases of the flux their faculties vary even as their appearances. If one insists upon calling both of them soul—for from earth comes water, from water soul (*fragment* 36)—, one must admit still that they are soul in different degrees of intensity, just as the moist soul of the drunken man is less soul than that of a child (*fragment* 117).

<sup>65</sup> Diogenes, *fragment* 5.

<sup>66</sup> Cf. page 294, note 15 *supra*.



docles. The elements play the rôle of matter;<sup>67</sup> but there must be some unifying principle in the combinations of them, and whatever that principle is it is obviously supreme in its dominance of the material.<sup>68</sup> That anything should be dominant over the soul, however, Aristotle says is impossible, still more impossible that anything should be superior to mind which in its nature is prior and dominant. That the elements are the primary existences, as the Presocratics say, means to Aristotle that the material cause is prior to the form, which, since for him matter implies potentiality and form actuality, is absurd. Although nothing is directly said of the doctrine at the present point, it is evident that the argument is considered conclusive proof that soul must be opposed to the so-called elements as form to matter, as final to material cause.

Considering the soul as the principle of life Aristotle now turns to criticize both the notion that it is the cause of motion and the theories which present it primarily as the means of cognition and sensation. Neither of these views is broad enough and so neither one nor both together can furnish a correct definition of the soul. There are some animals which, though sentient beings, have no power of locomotion, although locomotion is the one movement that the soul of itself is supposed to impart to the body. On the other hand, plants have life but neither locomotion nor sensation and many animals have both

<sup>67</sup> The curious expression *ὅλη γὰρ ἔοικε* is intended to signify that they are not "matter" in the Aristotelian sense of pure potentiality but merely approach that concept. Cf. the similar use of *ἐν ὅλης εἶδει* to signify the material principles of the Presocratics, *Metaphysics* 983 B 7-8, 985 A 32 (*τὰ ὡς ἐν ὅλης εἶδει λεγόμενα στοιχεῖα*), etc.

<sup>68</sup> So in *De Generatione* 334 A 9-15 Aristotle attacks Empedocles for deriving the soul from the material elements. If it consists of the elements or is any one of them the psychical alterations are inexplicable, he says, for the characteristics of such a thing could be only material just as, if the soul were fire, its changes would be only those that occur to fire *quâ* fire. But the change from being a musician to not being a musician and conversely and memory and forgetfulness and all such changes of the soul are not material.

In the *De Anima* passage the necessity of the soul as form is argued from the necessity of some principle to unify the materials of the body; but the notion of the soul as the unifying principle of sensations and so as the unifying principle in general evidently derives from Plato (cf. *Theaetetus* 184 D).

of these faculties but no discursive reason.<sup>69</sup> The notion expressed in the Orphic poems, so-called,<sup>70</sup> displays, he says, the same narrowness, for the soul is said to be borne on the wind and breathed in by the body. Plants, however, and some animals do not breathe, so their vital principle cannot be accounted for in this manner.<sup>71</sup>

Conversely, those who regard the soul as diffused in the whole universe give it a significance which is too broad,<sup>72</sup> for, if there is soul in air or fire and it is thought to be purer in that state than in the compound bodies, it is hard to see why it produces a living being in the latter and not in the former. Neither is it clear why the soul in air is better and more immortal than that in living beings. Anyway it is unreasonable to call air or fire an animate being<sup>73</sup> but absurd to refuse to call it so if there is soul in it. This notion of the diffusion of soul, Aristotle says, arose presumably from the observation

<sup>69</sup> Aristotle's point is that in defining the soul sensation and thought cannot be treated as the same thing or as due to the same cause, for, if the soul as such is the principle of both, there is no reason why everything that has a soul should not think as well as perceive. The case of sensation and motion is analogous. In short, there must be different "kinds" of soul. If the mind and sensitive faculty be taken as "parts" of the soul, still the definition would not account for all soul or for any one complete soul (410 B 24-27), because plants have only a vegetative soul and sensation and intellection cannot exist in any soul which has not also a vegetative part. Aristotle means that the most fundamental function of the soul, the nutritive-generative element, is neglected in all these explanations.

<sup>70</sup> On Aristotle's denial of the authenticity of the poems of Orpheus cf. Aristotle, *fragment* 7.

<sup>71</sup> This objection would, if it were true, invalidate the Atomistic connection of respiration with the soul (cf. page 291, note 5 *supra*).

<sup>72</sup> *De Anima* 411 A 2-7 (cf. page 306, note 60 *supra*) interrupts the context (cf. Bywater, *Journal of Philology*, XVII, pp. 53-54). The theory of the "diffused soul" obviously includes the Orphic opinion just mentioned and so is in one sense too narrow, in another too broad. The mention of air and fire in 411 A 9-10 shows that Aristotle believes his objections here apply to the theories of Diogenes and Heraclitus, also. For the statement in 411 A 8 to the effect that Thales also probably held this view, cf. page 296, note 26 *supra*.

<sup>73</sup> That Aristotle here implies a sharper distinction between animate and inanimate nature than his own system warrants is well expounded by Rodier, *Traité de l'Ame*, II, 158-160.



that the whole of each element is homogeneous with its parts so that, if the parts of the elements in organic bodies are alive, the whole of each element must be alive also.<sup>74</sup> This argument from homogeneity, however, he turns against the theory. If animate beings have soul by reason of the interception in their bodies of a part of the environing air, the soul must also be homogeneous. Since the soul manifests different faculties in different beings, however, it cannot be homogeneous; and consequently, if the air when divided into parts is still homogeneous and the soul is not, not all the soul can be in all the air and the argument from homogeneity breaks down.

Such are Aristotle's arguments against the earlier conceptions of soul which made it motive by reason of its own mobility and derived its cognitive and sensitive faculties from the nature of its material constituents; and in his refutation of these conceptions the foundation of his own theory is clearly discernible, the soul is the cause of the living body in three senses, as source of motion (that is as original efficient cause), as final cause, and as essence or formal cause.<sup>75</sup> It is in this sense that Aristotle maintains that the soul is the cause of locomotion, alteration (which includes sensation), and growth and decay, which take place in material but cannot be attributed finally to matter as their cause.<sup>76</sup> This is a fundamental difference between his doctrine and all those which explained these functions by sheer physical mechanism; and Aristotle attempts to show that mechanical explanations of growth fail to account for the most significant feature of the organism, namely its definiteness of form exemplified in its unity. Empedocles, he says,<sup>77</sup> was wrong in attributing the downward growth of plant roots to the natural tendency of the earth in them and

<sup>74</sup> Hicks refers to Plato, *Philebus* 29 A-30 B from which passage Aristotle took over this reconstruction. Plato does not give any hint as to his source, and the details of the argument are probably his own, for the distinction of soul and matter is too clear for real animists. But the germ of the argument appears in Diogenes, *fragment* 2, although he attempts to combine generic homogeneity and specific difference in *fragment* 5.

<sup>75</sup> Cf. *De Anima* 415 B 7-21.

<sup>76</sup> *De Anima* 415 B 28-416 A 9.

<sup>77</sup> *De Anima* 415 B 21-28.

the upward growth to the opposite tendency of fire in the plants.<sup>78</sup> In the first place, he did not correctly understand the terms "up" and "down," for these directions are not the same for all individuals as they are for the universe; since comparative morphology establishes the identity and difference of the organs in various species on the basis of function, the roots of plants correspond to the heads of animals and so "upward" for a plant would be "downward" for an animal.<sup>79</sup> Such a mechanistic system as that of Empedocles overlooks function completely and so neglects the final cause for the variation of organs, Aristotle contends. If the direction of motion of fire determines upward growth, presumably the upper parts of all organisms should have the same nature; and that they obviously do not. But, in the second place, such motions of earth and fire proceeding in opposite directions would rend the organism apart unless there were some preventive force.<sup>80</sup> The unity of the plant or animal is an outward sign of the dominance of the formal cause which must be

<sup>78</sup> The source of Aristotle's notion that Empedocles at times attributed the motion of the four roots to some cause other than "Love" and "Strife" appears in *De Generatione* 334 A 1-5 where he quotes two lines (*fragments* 53 and 54) which in themselves offer no support for the conclusion there stated *ὅτι δὲ φησι πεφυκέναι τὸ πῦρ ἄνω φέρεσθαι*. (A more plausible quotation would have been *fragment* 62, 6: *τοὺς μὲν πῦρ ἀνέπεμπε θέλον πρὸς ὁμοῖον ἵκεσθαι*, where, however, *θέλον ἵκεσθαι* does not mean "indem es . . . hinstrebte" as Diels translates but refers to the obedience of fire to "Strife" which is in process of segregating the roots.) On the whole question of the causes of movement and mixture in Empedocles' system cf. pages 190, note 192; 190, note 193 *supra*. (Aristotle himself implicitly denies that Empedocles attributed "natural motions" to the "roots" in *De Caelo* 309 A 19-20; cf. Aëtius, II, 7, 6.) Theophrastus substitutes *αἰθήρ* for *πῦρ* in giving this explanation; cf. Gilbert, *Meteorologische Theorien*, p. 338, n. 1.

<sup>79</sup> Cf. *Parva Naturalia* 468 A 1-12, *De Incessu Anim.* 705 A 29-B 8.

<sup>80</sup> Empedocles probably thought of the unity of the organism, which is but a temporary thing anyway, as the resultant of the opposite forces of "Love" and "Strife" simultaneously affecting the materials of the body. This mechanism Aristotle neglects (cf. pages 189 f. *supra*); but Empedocles would still be hard put to it to explain the unity of action, thought, and sensation on this basis. It is not likely that he would have attributed any such function to the soul which is entirely dissociated from the mechanism of the body (cf. page 294, note 15 *supra*).



something apart from the mere mechanical stresses of the material. That, Aristotle says, is the soul; and, as the growth which results from nourishment proceeds in accordance with this unity and form, the soul must be the cause of growth also.<sup>81</sup> This definite limit of organic growth also refutes the opinion that the nature of fire is itself the cause of nourishment and growth, which opinion, Aristotle says, is based upon the observation that fire alone of the simple bodies takes nourishment and grows.<sup>82</sup> This might lead one to suppose that fire is the motivating cause in living beings, whereas it is not strictly the cause but the necessary instrument of the cause in its activity.<sup>83</sup> Fire is material, and there is no limit to its growth so long as it has fuel for nourishment; but in organic bodies there is always a limit to increase and size which must be due to the formal cause and not to matter.

<sup>81</sup> Cf. page 233 *supra*.

<sup>82</sup> *De Anima* 416 A 9-18. The reference is apparently to Heraclitus, cf. *Meteorology* 354 B 33-355 A 15 and page 133, note 541 *supra*. (The statement of Simplicius [*Physics*, 24, 6-8] that Heraclitus and Hippasus decided that fire is the primary element from observing the vital functions of heat is his own conjecture. Zeller, himself, though apparently approving this statement, admits that the notion of fire as the true nature of the world followed from the thesis that all things are in constant flux; cf. Zeller-Nestle, *op. cit.*, I, 813-814.) It is not, however, clear that the reason here given for the theory that fire is the cause of growth is more than a reconstruction of Aristotle's; in fact, the statement of the thesis itself may be nothing more than Aristotle's interpretation of the theory that "the soul is fire." See *De Part. Animal.* 652 B 7-15 where, in discussing the vital heat and its source, he refers to some who suppose the soul to be fire or some such potency and says that it would be better to say that the soul resides in such a body, for heat is the chief instrument in the performance of the soul's functions. The soul nourishes and moves the body chiefly by means of heat; but to call the soul fire is like saying that the saw is the carpenter or carpentry. In this passage the reasons for the thesis that soul is fire are not given; it is simply assumed that the soul as the origin and cause of vital processes was confused with what Aristotle himself considers to be the chief instrument by which those processes are brought about. The words *πῦρ ἢ τοιαύτην τινὰ δύναμιν* (652 B 8) suggest, indeed, that not only the Heraclitean but also the Atomistic theory is meant.

<sup>83</sup> For the importance of vital heat (not strictly fire but *πνεῦμα* which is analogous to the fifth essence) cf. *De Gen. Animal.* 789 B 7-15, 736 B 33-737 A 7, *De Part. Animal.* 681 A 2-7, 669 B 3-6.

The other faculty of soul generally accepted is that of cognition and perception; Aristotle has already proved that the soul cannot be aware of external objects in the way and for the reasons maintained by the Presocratics. He further charges explicitly that the ancients identified knowledge and perception and proceeds to refute this thesis.<sup>84</sup> The similarity of thought and sensation lies in the fact that in both processes the soul discriminates and recognizes something particular. That Empedocles identified the two processes Aristotle seeks to prove by two lines from his poem;<sup>85</sup> and he says that Homer intended to express the same notion in the lines beginning "such is the mind."<sup>86</sup> He then states generally that all the early thinkers conceived thought like sensation to be corporeal and the procedure of both to be the same, the influence of like upon like.<sup>87</sup> Following the method of Plato in the *Theaetetus* Aristotle attacks this conception of cognition by pointing out that it does not account for error, although error is more common in the souls of living beings than true knowledge and so should be explained. If knowledge and sensation be identified, however, either all appearances must be true as some, indeed, say,<sup>88</sup> or, since knowledge results from the interaction of similars, error must be due to the contact of dissimilars. But the latter alternative is impossible, for the knowledge or ignorance of

<sup>84</sup> *De Anima* 427 A 17-B 14.

<sup>85</sup> *Fragments* 106 (cf. page 80, note 328 *supra*) and 108. Aristotle misquotes the latter, writing *ὅθεν σφίσιν αἰεὶ καὶ τὸ φρονεῖν ἄλλοῖα παρίσταται* instead of *τόσον ἄρ σφίσιν κτλ.*

<sup>86</sup> Aristotle quotes *τοῖς γὰρ νόος ἐστίν*, the beginning of *Odyssey*, XVIII, 136-7 which continues: *ἐπιχθονίων ἀνθρώπων οἶον ἐπ' ἡμαρ ἄγῃσι πατὴρ ἀνδρῶν τε θεῶν τε*. Aristotle thinks that from "the shiftings of thought" which he sees implied in these passages he can conclude that thought for the ancients depended upon external objects in their relation to the state of the body and so that thought and sensation were by them identified. Cf. page 292, note 9 *supra*.

<sup>87</sup> On the matter of the identification of thought and sensation by Democritus, Empedocles, Parmenides, and Anaxagoras whom Aristotle specifically charges with this error in *Metaphysics* 1009 B 11-33 cf. pages 79-83 *supra*. Heraclitus, also, obviously distinguished sensation from intelligence (cf. *fragments* 107, 56, 34, 17, 41 and Nestle, *Philologus*, LXIV [1905], pp. 376 ff.) and Alcmaeon explicitly contrasted the two (cf. page 299, note 32 *supra*).

<sup>88</sup> Cf. page 292, note 10 *supra*; and Protagoras, pages 77 ff. *supra*.



one of a pair of contraries implies simultaneous knowledge or ignorance of the other contrary term.<sup>89</sup> Furthermore, all animals have sensation while only a few have intelligence, so that the two must be different; and, if one distinguishes right thinking from wrong thinking, the difference between the two processes is further marked, for perception of the proper sensibles is infallible<sup>90</sup> and a characteristic of all animals but thinking may be false and is restricted to the animals that have reason.<sup>91</sup>

Thought, then, cannot be explained by a mechanism of physical contact; but Aristotle likewise maintains that such a theory is inadequate for the explanation of sensation itself and charges most of the physical philosophers and specifically Democritus with the error of reducing sensation in general to the single sense of touch,<sup>92</sup> for they make all sensible qualities mere tactility.<sup>93</sup> The necessity for a medium in sight, hearing,

<sup>89</sup> Cf. page 306, note 60 *supra*.

<sup>90</sup> Cf. *De Anima* 418 A 11-18, 428 B 18-30.

<sup>91</sup> The argument is similar to that which was used to prove that the soul can not be defined as the principle of motion or of sensation (cf. page 308 *supra*). If sensation and thought be identified, all animals that perceive must think, which is obviously false. In *Post. Analyst.* 87 B 28-88 A 8 Aristotle distinguishes sensation and knowledge in a different fashion, arguing that sensation is of the particular whereas the demonstrations of causes are universal in character. It is not true, he says, that, if one could *perceive* that the angles of a triangle equal two right angles, one would, as some say, *know* it. One would still seek a proof of the fact which would consist in understanding the cause; that alone is knowledge and contains an element of universality not to be found in sensation, although the universal becomes clear through repetitions of the particular. The particular opponent in Aristotle's mind here is probably Antisthenes (cf. Zeller, *Philosophie der Griechen*<sup>5</sup>, II, 1, p. 294, n. 1 and Prantl, *Geschichte der Logik* [1855], p. 32); but the argument is meant to apply to all identification of thought and sensation as well as to the derivation of knowledge from a mere combination of sense-perceptions, and Aristotle would probably think it cogent against such statements as that of Democritus cited in *De Part. Animal.* 640 B 32 (cf. page 259, note 168 *supra*).

<sup>92</sup> *De Sensu* 442 A 29-B 23.

<sup>93</sup> This is particularly clear in the Atomistic and Empedoclean mechanism of "effluences" whereby the senses of sight, hearing, and smell are explained. This was the most circumstantial theory of sensation; but Alcmaeon and Anaxagoras, so far as can be made out from Theophrastus' account (*De Sensibus*, 25-30), also made all sensation the direct result of physical contact. (Cf. also Theophrastus, *ibid.* 38-42 for Cleidemus and Diogenes.)

and smell appears to Aristotle conclusive evidence for his contention that these sensations at least are not the result of contact;<sup>94</sup> and from the fact that the sense-organs, although constituted of sensible materials,<sup>95</sup> have no sensation of themselves he concludes that the faculties of sense are potentially the same as the sensible objects and that sensation itself consists in the actualization of this potentiality, that is the assimilation of the sense to its object in so far as it becomes the form of the object without the material.<sup>96</sup> These thinkers further err, Aristotle says, in treating the "common sensibles" as if they were objects of the special senses, whereas figure, shape, sharpness, and such characteristics of body are common objects of sight and touch at least, which is the reason for the fact that the perception of them may be erroneous while that of the special sensibles is infallible.<sup>97</sup> They then reduce the special sensible

<sup>94</sup> For taste and touch the media are not foreign bodies but the flesh itself. Cf. *De Anima* 419 A 15-B 2; 422 A 8-17; 423 A 13-21.

<sup>95</sup> In *De Anima* 424 B 22-425 A 13 Aristotle attempts to prove that there are no more than five senses on this basis. If a sense be lacking, this implies the lack of a corresponding sense organ. The sense organs, however, must be constructed of one or more of the simple bodies. Of these there are only four, of which only air and water can form the essential constituent of a sense organ (fire entering into all in so far as they are sentient, earth being present only in the organ of touch). Now the animal that has an organ consisting of one of these sensitive media will be able to perceive everything that is perceptible through that medium. Such organs some animals possess (the eye is made of water, the organ of hearing of air, the organ of smell of either one or the other). If there is no other simple body, then, or no quality other than the qualities of the bodies in this world, there can be only the five senses we know. This argument, it has already been said, really assumes a premise not herein stated (cf. page 5 *supra*). It has been suggested (cf. Rodier, *Traité de l'Ame*, II, 347; Hicks, *De Anima*, pp. 422-423) that this passage is an answer to Democritus. In what sense, however, Democritus may have meant that the five senses are not exhaustive is not clear (cf. Zeller-Nestle, *op. cit.*, I, 1125, notes 2 and 3), and the absence of any suggestion by Aristotle that he had in mind some contrary doctrine leaves open the possibility that the passage is meant only to show that his treatment of the special senses is exhaustive. This possibility is supported by the fact that he proceeds (*De Anima* 425 A 13 ff.) to argue that the "common sensibles" are without a special sense-organ; certainly no one had maintained the opposite view (cf. *De Sensu* 442 B 4-5: τοῖς κοινοῖς τῶν αἰσθήσεων πασῶν χρῶνται ὡς ἰδίῳ).

<sup>96</sup> Cf. *De Anima* 417 A 2-20, 418 A 2-6, 425 B 25-426 A 19.

<sup>97</sup> Cf. *De Anima* 418 A 7-25.



qualities to those that are common, as Democritus says that white is smooth and black rough and refers the various flavors to various figures;<sup>98</sup> but, in that case, Aristotle argues, sight ought to be able to discriminate flavors most accurately or, if taste can best distinguish the "common sensibles" in flavor, shape and figure should be most accurately distinguished by taste also. Finally, all the special sensibles display contrariety but there is no contrariety in figure, so that difference of shape cannot be the basis of the differences in colors or flavors. There is, in fact, an infinite variation of figure and consequently there ought to be an infinite number of flavors; Aristotle refuses to admit the possibility of imperceptible variations of quality, for such a theory seems to him to destroy the intelligibility of nature.<sup>99</sup> To refer all the senses to tactility, however, is to reduce qualities to quantitative difference and thereby to dissolve the world of sense into relativity.

The faculties of sense are not themselves material, but Aristotle is concerned not with the faculties alone but also with the material nature of the organs in which they arise, for the material of each organ is determined by its formal cause or function. In this investigation he has occasion to criticize his predecessors chiefly in regard to vision and the eye, which, he says, everyone supposed to consist of fire.<sup>100</sup> This notion was due, he explains, to a misunderstanding of the cause of the apparent gleam which is seen when the eyes are pressed and moved,<sup>101</sup> a phenomenon which occurs in the dark or when the eyes are closed. If this really were the perception by the eye of fire in itself, Aristotle contends that the eye ought to perceive itself when at rest in

<sup>98</sup> Cf. Theophrastus, *De Sensibus*, 74 and 65-67.

<sup>99</sup> Cf. pages 5 and 12 *supra*.

<sup>100</sup> *De Sensu* 437 A 22-438 A 16. In 437 A 20-22 with regard to the sense-organs generally he says *νῦν μὲν ζητοῦσι κατὰ τὰ στοιχεῖα τῶν σωμάτων. οὐκ εὐποροῦντες δὲ πρὸς τέτταρα πέντ' οὐσας συνάγειν, γλίσχονται περὶ τῆς πέμπτης*. The *νῦν μὲν* seems to imply that the tendency referred to is contemporary and probably refers to the doctrine of Plato's *Timaeus* (cf. Alexander, *De Sensu* 14, 22-15, 4).

<sup>101</sup> A similar phenomenon, according to Theophrastus (*De Sensibus*, 26), was adduced by Alcmaeon as evidence for the presence of fire in the eye.

the dark as well as when in motion; but it is at least not conscious of itself in these circumstances, so that it must not have any sensation of itself when at rest, for unconscious sensation is impossible. The "gleaming" in question Aristotle himself tries to explain on the assumption that the pupil of the eye, like all "smooth" objects, is luminous in the darkness but produces no light<sup>102</sup> and that swift motion causes the eye to be reduplicated as it were, so that what sees and what is seen appear to be distinct.<sup>103</sup> That the eye cannot be fire as Empedocles says and as it is described in the *Timaeus*<sup>104</sup> and that vision cannot be due to the streaming of fire forth from the eye the fact that there is no vision in darkness proves. The Platonic combination of external and internal fire is for the moment neglected and the theory that the fire of the eye is quenched by darkness is attacked instead.<sup>105</sup> As for Empedocles, Aristotle remarks that he sometimes appears to attribute vision to fire emerging from the eye and at other times to say that it results from effluences from the visible objects.<sup>106</sup> Further con-

<sup>102</sup> Cf. *De Anima* 419 A 2-6.

<sup>103</sup> Alexander (*De Sensu*, 19, 12 ff.) supposed this to mean that one part of the eye sees the other part. G. R. T. Ross objects that in that case the necessity for swift motion is not explained and suggests that Aristotle thought the eye in one position could see itself in an earlier position if the movement were rapid enough. Aristotle may have thought that the swiftly moving eye creates a luminosity which seems to be continuous and separate from itself, just as a glowing stick if swiftly moved seems to produce a line of fire separate from itself, and that it is this luminosity that the eye sees as if it were a separate object.

<sup>104</sup> Cf. Plato, *Timaeus* 45 B-E.

<sup>105</sup> *De Sensu* 437 B 14-23.

<sup>106</sup> To support the first part of the statement it is clear that the best evidence Aristotle could find in Empedocles' poem is the quotation he gives (*fragment* 84) here, a comparison of the eye to a lantern with its shield that wards off wind and rain and lets the light pass through. Burnet (*E. G. P.*<sup>3</sup>, p. 248) says without reserve that Empedocles thought the fire passes out of the eye in vision, but he is not sure how this was reconciled with the theory of effluences; Zeller (Zeller-Nestle, *op. cit.*, I, 994) definitely attributes to Empedocles the theory of Plato's *Timaeus*, the fire-ray from the eye meeting the effluence from the object outside of the eye. Zeller thought the words *φῶς ἔξω διαθρῶσκον* in the fragment, the present Aristotelian passage, and the commentary of Alexander thereon should settle the matter. But Alexander merely repeats Aristotle and never suggests any combination of the two "rays" in the fashion of the *Timaeus*;



sideration of Empedocles' theory is not taken; he has shown that Empedocles thought the eye to contain fire, and it is this notion that he is chiefly concerned to controvert.<sup>107</sup> Democritus supposed the eye to be moist, and Aristotle praises him for this but objects to his theory that vision consists in the mirroring of

Aristotle says nothing of such a combination and implies that the two explanations are contradictory, implying that he could not be sure which one Empedocles really held; and the passage from Empedocles, the sole evidence Aristotle could find for attributing to him the theory of emergent fire from the eye, is a simile concerning the structure of the eye without a word about vision or its cause. That the fire within could emerge from the eye Empedocles no doubt believed, since there were pores in the membrane through which the effluences from without passed; and the gleaming and "flashing" of the eyes had to be accounted for even apart from vision. Theophrastus (*De Sensibus*, 7), just after giving an account of Plato's theory, outlines that of Empedocles, mentions the substance of the lines quoted by Aristotle, but gives no hint of outward streaming fire as the cause or even the conjunct cause of vision; the colors are brought to the organ of sight by effluence and are perceived by the mechanism of fiery and aqueous pores in the eyes. And Plato in the *Meno* (76 C-D) gives the same account without mentioning fire at all. It is safe to say, then, that the notion that Empedocles somehow used both effluences of fire from the eye and effluences from visible bodies to explain vision arose from this passage of Aristotle which suggests no combination of the two but from a poetic simile seeks to find an inconsistency in the words of Empedocles himself (cf. also Millerd, *op. cit.*, pp. 84-85). Apuleius (*Apol.* 15 = Archytas, 35 A 25, Diels) attributes to Archytas a theory of vision based upon rays of vision alone; this suggests that Plato's theory was a combination of those of Empedocles and Archytas.

<sup>107</sup> In *De Gen. Animal.* 779 B 15-780 A 6 he refers more plainly to Empedocles' doctrine that the eye is a combination of water and fire and attacks his explanation of the color and strength of eyes on this basis. Empedocles, he says, thought that blue eyes have more fire in them, dark eyes more water and that for this reason the former from deficiency of water are less keen by day, the latter from deficiency of fire see less sharply by night. This explanation, Aristotle says, is false because the vision of the eye depends on water in all cases, not on fire. He, then, tries to explain both color and sharpness of sight by the various amounts of liquid in the eye, the greater amount being less transparent and so darker just as in the case of the sea, the color of which varies with its depth. So too blue eyes, having little liquid, are too violently disturbed by light and so see poorly by day; dark eyes have too much liquid to be sufficiently moved by weak light and see poorly in the evening. The motion of this liquid quâ diaphanous not quâ liquid is sight. Though Aristotle does not explain this point, Empedocles must have meant that in the day-time the more fiery eye can distinguish fewer "dark" things since it is by means of water that they are perceived. in the night the darker eye can distinguish fewer "bright" things which

the object in the eye<sup>108</sup> that the appearance of the image in the pupil is a case of reflection due to the smoothness of the pupil and exists not in the reflecting pupil but in the person who sees the reflection.<sup>109</sup> Such a theory was due to the fact that the phenomenon of reflection had not yet been clearly explained, he says; but even so Democritus might have seen its inadequacy by considering that reflections occur in many other objects besides the eye, yet of these only the eye has vision. The organ of sight, then, is constituted of water but it has sight not quâ aqueous but quâ diaphanous. This quality is for Aristotle the medium of vision,<sup>110</sup> and both air and water share in transparency so that either may be a medium of vision,<sup>111</sup> but water is more easily confined within limits than is air and for this reason is the material constituent of the eye.<sup>112</sup>

require fire in the eye to be perceived. Here we have another example of the use of "psychological contrast" in a theory based upon interaction of similars.

<sup>108</sup> Cf. Theophrastus, *De Sensibus*, 50; page 165, note 100 *supra*; Bailey, *Greek Atomists and Epicurus*, pp. 165-70.

<sup>109</sup> Aristotle means that this is just such a case as he referred to in 437 B 9-10: αὐτὸς αὐτὸν ὁρᾷ ὁ ὀφθαλμός, ὥσπερ καὶ ἐν τῇ ἀνακλάσει; and the meaning is clarified below in 438 A 10-12 where in reflection it is plain that the image has no real connection with the object in which it is mirrored but only with the subject that sees it.

<sup>110</sup> Cf. *De Anima* 418 A 26-B 20, *De Sensu* 439 A 18-B 16.

<sup>111</sup> Cf. *De Anima* 425 A 1-2; 435 B 21-22; *De Sensu* 438 B 2-16.

<sup>112</sup> There follow (*De Sensu* 438 A 17-25) certain facts in proof of this contention: the injured eye emits water; in young embryos the eyes are cold and gleaming; in animals with blood the white of the eye is oily to keep the eye from freezing, for which reason the eye never feels cold; bloodless animals have a hard skin covering to protect the eye. He then turns to attack the Platonic theory of a combination of light from the eye and light from the object meeting to produce vision (*De Sensu* 438 A 25-B 2); this criticism is introduced by the general statement that it is absurd to account for vision by the assumption of an emanation from the eyes which can travel as far as the stars. This seems to refer to the interpretation of Empedocles' simile (*De Sensu* 437 B 23-438 A 3), the "reaching to the stars" being probably a reference to λάμπεσκειν κατὰ βηλόν in the poem. If this is so, Aristotle took the words as Diels did ("leuchtete zum Firmament"). Bignone objects that βηλός means "threshold of heaven" and translates "all' orizzonte." But no lantern ever shone to heaven or to the horizon; the words simply mean "over the threshold" of the house which the man prepares to leave on his journey through the storm (so apparently G. R. T. Ross also understands it).



The fundamental objection of Aristotle to all previous theories of vision is that they assume a direct mechanical relation between the visible object and the sense-organ. Such a mechanism he proposes to reject in favor of a theory which gives universal scope to his principle that the sense is potentially the sensible object which it becomes actually when stimulated by the form that has been actualized in the medium by the ultimate object of sense, this medium in actualization having become a continuous link between the object and the organ. The same intention motivates his criticism of previous explanations of taste and smell, in both of which cases he objects to the tendency to bring the ultimate object of sense in direct physical contact with the organ. With regard to taste this difference between Aristotle's theory and earlier explanations might seem to disappear, since for him, too, taste is a species of touch;<sup>113</sup> but the earlier theories identified the flavors with physical particles which act mechanically upon the tongue and in so avoiding the explanation of the sensation as a qualitative alteration prevented the possibility of understanding the sense as already being potentially the flavor that it later becomes actually.<sup>114</sup> Since flavor was universally connected with water or liquid, the issue resolves itself into the manner in which the flavor resides in the liquid.<sup>115</sup> The first theory mentioned by Aristotle supposed the various kinds of flavors to be present in water in quantities too small to be detected; this theory is connected with the name of Empedocles. According to the second theory water is "a kind of material of flavors," a *πανσπερμία* from which all flavors arise, some in one part of it, some in another. The third possibility is that water itself is undifferentiated but under the influence of some agent such as heat can take on the various flavors. These represent the only possible explanations of the fact that water itself is tasteless whereas various flavors develop in it.<sup>116</sup> The first explanation is refuted

<sup>113</sup> *De Sensu* 441 A 3, *De Anima* 422 A 8-14.

<sup>114</sup> Cf. *De Sensu* 441 B 21-23.

<sup>115</sup> *De Sensu* 441 A 3-B 23.

<sup>116</sup> G. R. T. Ross assigns the first theory to Empedocles, the second to Democritus (so Alexander, *De Sensu*, 68, 24 ff.), the third to Anaxagoras. But notice that Aristotle says these are the *only possible* explanations, not that they are

by the fact that the flavor in picked fruits changes when the fruits are placed in the sun; the new flavor must be due to an alteration under the influence of heat. The second theory is also disproved by the fact that different flavors develop in different plants that use the same water for their nourishment. This leaves only the third possibility which cannot be the exact explanation either, for flavors are denser than water and water does not thicken when heated. Now the flavors of fruits all exist in the soil, for which reason many early thinkers attributed the quality of water to the nature of the earth through which it had passed.<sup>117</sup> This, however, is not the direct result of earth as such upon water as such; there is a qualitative alteration in which the dryness of earth and of fire acts upon the moistness of water, and the liquid in percolating through earthy substances is qualitatively changed by the dryness.<sup>118</sup> The result is a quality which is in turn capable of bringing to actuality the taste already existing potentially in the sense-organ.

The case of smell and odor is similar but presents a further

three earlier theories. The third implies doctrines that no one before Aristotle could have held, e.g. the alteration of an undifferentiated substrate; and even Plato, who stressed the influence of fire on flavors, thought of this influence as a "mixture" of fire molecules with water (cf. Gilbert, *Meteorologische Theorien*, pp. 362-363 and notes). The third possibility is a suggestion of Aristotle's own which is, in fact, taken up in his own theory as finally formed. Anaxagoras' notion is the second theory as Alexander himself (*De Sensu*, 68, 8 ff.) admits. One flavor would arise in one part, another in another, because while all flavors would be present everywhere, the one that predominates in a given locality would alone be perceptible. It is better to suppose the Atomistic theory to fall under the first heading along with that of Empedocles, since Democritus made flavor the result of the shapes of the atoms and this the phrase *ἀνασθητα διὰ μικρότητα* fits as well as it does Empedocles. The minuteness of the atoms makes their presence indiscernible by taste unless one type is present in large numbers.

<sup>117</sup> Cf. Plato, *Phaedo* 112 A 6-7; page 131, note 531, pages 138-139 *supra*.

<sup>118</sup> The heat here is spoken of as an agency in the percolation. There can be no doubt, however, that the details of the theory are here obscured. The earth is constantly changing into the "dry exhalation" and the chief reaction in the production of flavor occurs between the "dryness" of this exhalation in the earth and the moisture of water. This explains the changing flavor in the plucked fruit under the influence of heat and also the close analogy between flavors and odors, the latter being connected also with the dry exhalation (cf. *De Sensu* 438 B 24-25, 443 B 3-8).



distinction, since earlier thinkers all supposed smell to be due to the direct application of the sensible material to the organ and so made it a species of touch whereas Aristotle believed a medium similar to those of sight and hearing necessary for smell also.<sup>119</sup> The smoky vapor, he says, was by some people identified with odor<sup>120</sup> and hence arose the saying of Heraclitus that if all things became smoke the nostrils would distinguish them.<sup>121</sup> Aristotle's notion that the fact that this smoky vapor is common to earth and air was the reason for the belief of earlier thinkers is obviously false, since it rests upon his own theory of exhalations as intermediate stages in the alteration of the elements, the result of incomplete change of one of the pair of qualities of which his four "simple bodies" consist. At any rate, he says that everyone referred odor to this sort of thing, some to vapor, some to the dry exhalation, some to both; and having then distinguished vapor as moist from the smoky exhalation as dry, from the first of which water results and a kind of earth from the second, he argues that neither can be odor. Vapor is water and so cannot be the odor in air; the dry exhalation being earth cannot exist in water, yet creatures that live in water do have a sense of smell.<sup>122</sup> Against the theory that both might be odor he brings no special argument; but his real objection appears in the statement that such a theory is the same as a theory of effluences and that since the latter is false the former is erroneous on the same grounds.<sup>123</sup>

The theories so far considered represent, according to Aristotle, the soul as a material substance; there is, however, another opinion which makes the soul a harmony on the ground that harmony is a compound and combination of opposites and the

<sup>119</sup> Cf. *De Anima* 419 A 25-30.

<sup>120</sup> *De Sensu* 443 A 21-B 2.

<sup>121</sup> Heraclitus, *fragment* 7.

<sup>122</sup> Cf. *De Anima* 421 B 10-13.

<sup>123</sup> Although the medium of smell in animals that respire is air, it cannot be so for bloodless animals which do not breathe. This belief that some animals do not respire was a stumbling-block to Aristotle's understanding of the sense of smell. That a medium is necessary he thought was proved by the fact that there is no sensation of odor if the object be placed directly upon the organ of smell. (Cf. *De Anima* 421 B 13-26.) For the relationship of the theory of a medium to Aristotle's doctrine of motion see page 165 *supra*.

body, too, is constructed of contraries.<sup>124</sup> Harmony in this sense, however, will be either a proportion or ratio of the components in the body or else the composition itself, and the soul can be neither of these, says Aristotle, for<sup>125</sup> there are many compositions of the parts which are connected in various fashions and one would have to designate the composition which is the mind, the one which is the sensitive faculty, the one which is the appetitive faculty, and so on. Similarly, if harmony be meant

<sup>124</sup> *De Anima* 407 B 27-408 A 29. In *Politics* 1340 B 17-19 he refers again to this opinion saying that because there seems to be an affinity between harmony and the rhythms of movement (which themselves differ in *ῥθμος*) "many of the wise say" that the soul is harmony or again that it has harmony. The theory is ascribed to the Pythagoreans and even to Pythagoras by late commentators (Macrobius, *Somnium*, I, 14, 19: Pythagoras et Philolaus harmoniam < dixerunt animum >; Philoponus, *De Anima*, 70, 5 ff., who interprets it to mean that the soul is a number). Plato in the *Phaedo* (85 E ff.) puts it into the mouth of Simmias and says that it was accepted also by Echecrates (*ibid.* 88 D; cf. also 92 C-E). Since Simmias, Cebes, and Echecrates had been pupils of Philolaus, Burnet (*E. G. P.*<sup>3</sup>, pp. 295-296) supposes that it was the doctrine of Pythagoreans of the end of the fifth century, an application of the theory of Alcmaeon. We have the statement of Claudianus Mamertus (*De Stat. Anim.*, II, 7 = Diels, *Fragmente der Vorsokratiker*, 32 B 22) that Philolaus said the soul enters the body *per numerum* and survives the body as an immaterial being. This reference comes from an undoubtedly spurious work of Philolaus but accords much better with Pythagorean notions than the doctrine that the soul is merely the concord of the material elements of the body. If the Pythagoreans called the soul a "harmony" or "octave" in the sense of a number, this would be nothing strange since all things were by them considered to be number; but it would be far other than the theory here mentioned which was held by Aristotle's pupils Dicaearchus and Aristoxenus (cf. Cicero, *Tusc. Disput.*, I, 10; Aëtius, IV, 2, 7; cf. Theodoretus, *Graec. Aff. Cur.*, V, 18; Nemesius, *De Nat. Hom.*, 68 M [*Doxographi Graeci*, p. 387]). Aristotle never suggests that the doctrine was Pythagorean; it was most probably a late reinterpretation of some Pythagorean doctrine of the soul as number worked out by physicians or musicologists (cf. the passage from the *Politics* cited above) in the late fifth or early fourth century and not ascribed to the Pythagoreans until even later. Aristotle does not even deign to consider seriously Pythagorean statements about the soul; they are to him mere fables (cf. *De Anima* 407 B 22: κατὰ τοὺς Πυθαγορικοὺς μύθους, *Post. Anal.* 94 B 33: εἰ ὡς οἱ Πυθαγόρειοι φασιν ἀπειλῆς ἕνεκα τοῖς ἐν τῷ ταρτάρῳ < scil. βροντᾶν >, ὅπως φοβῶνται. The latter implies that the Pythagoreans believed the soul to survive the body).

<sup>125</sup> These objections are developed in 408 A 5-18, the general conclusion being given at 407 B 32-34 (cf. Bonitz, *Hermes*, VII [1873], pp. 428-436).



in the sense of ratio of mixture, the soul cannot be so defined, for there are various ratios of mixture for the various parts of the body, so that there would be many souls throughout the whole body. This second interpretation of "harmony" as ratio of mixture suggests to Aristotle the Empedoclean notion in which he is accustomed to find a foreshadowing of his own doctrine of formal cause;<sup>126</sup> and he suggests that, since Empedocles thought that it is in virtue of a definite proportion that each part of the body is what it is,<sup>127</sup> he too would have to decide whether this proportion is identical with soul or soul is something over and above this proportion. If the latter, Aristotle would deny that soul has been explained by him at all; if the former, the objections just raised in the case of harmony would apply. But, while Aristotle is eager to make clear the difference between this notion of soul and his own theory of it as form, and so insists that to call the soul harmony in either sense reduces it, in fact, to the matter in a certain arrangement,<sup>128</sup> he cannot avoid reading the theory of formal cause into Empedocles' merely mechanical notion of formula. In this sense, then, the proportion of mixture he supposes must have been the *cause* of the mixture; but how then, he asks, does "Love" come in as a cause of combination? Is it the cause of random combination only or of proportional combination? If the latter, "Love" must itself be proportion, for that

<sup>126</sup> Cf. page 233, note 75 *supra*.

<sup>127</sup> Empedocles did not himself make the general statement; Aristotle deduces it for him from his remarks about the constitution of bone (cf. *De Part. Animal.* 642 A 18-24).

<sup>128</sup> Cf. the statement of Rodier, *Traité de l'Ame*, II, 123: "l'harmonie du corps est donc seulement la matière dernière dont l'âme est la forme; autrement dit, elle est le dernier moyen de l'âme, en qui elle a sa raison et sa fin, et cette âme même n'est, à son tour, à chaque instant, que désir et tendance vers une réalisation plus complète de la forme qu'elle ne réalise encore qu'imparfaitement." The formal cause which is the soul has a double aspect; as already realized in the essence of the composite organism it is the cause of the creature's being what it is at any given moment, as in the process of being realized it is the final cause of the *activity* of the organism, for life is the striving of matter to be completely realized as form. The two aspects can never coincide just because the organism is composite, for matter is the potentiality which can never become pure actua' .

is the cause of proportional mixture—on Aristotle's interpretation—; then "Love" would be the soul. Or is it something apart from the soul? Empedocles himself, it has been seen, did not treat soul as the unifying vital principle; for him there seems to have been no principle of unity beyond the resultant of the opposing forces of "Love" and "Strife" which is the cause of all combinations, organic and inorganic alike. This mechanistic notion Aristotle could never clearly understand, although, if he had, he would certainly have rejected it on the grounds that caused him to assert the teleological theory of the primacy of the formal-final cause. In the present passage, however, he is interested not so much in refuting what he conceives to have been the theory of Empedocles as in setting off against his own doctrine of the soul the various implications of the notion that the vital principle is merely the relationship of the parts of the body to one another, a doctrine which at first sight might be easily confused with his own. This difference he emphasizes by saying that health or any such bodily excellence rather than the soul corresponds to the notion of harmony; such states might seem to be nothing more than the interplay of bodily parts, but it is very difficult to assign the psychical qualities and functions to any particular harmony. That the soul causes motion is almost universally asserted; but this is not the characteristic of an harmony.<sup>129</sup>

Although Aristotle rejects this theory he has a certain sympathy for it inasmuch as it attempts to explain the manner in which a specific soul and a specific body are related to each other, a fundamental point which he thinks most theories failed to consider;<sup>130</sup> and he remarks that to reject it presents diffi-

<sup>129</sup> The theory of the soul as harmony was discussed also in Aristotle's dialogue, *Eudemus*. Cf. the passages from Philoponus, Simplicius, Themistius, and *Scholia in Phaedonem* gathered by Rose as Aristotle, *fragment* 45. The arguments used in that dialogue were as follows. 1) There is a contrary to harmony, but soul has no contrary. 2) There is a contrary to the harmony of the body, namely disease, weakness, ugliness; if so, the harmony of the body must be health, strength, beauty. But even the ugliest man has a soul.

<sup>130</sup> Cf. *De Anima* 407 B 13-26 where after discussing the theory of the *Timaeus* he makes this objection against the Platonists particularly; but he men-

culties, too, for, if the soul is other than the mere mixture of the body, it is hard to see why it is destroyed along with the destruction of the essence of the parts of the living being and what it is that perishes when the soul leaves the body. The change at death is not a change in the material parts of the body separately; the soul, then, is other than the material but specifically related to the material in some way. This problem Aristotle solves by making soul the form of the organism, the first actuality of a natural, organic body; whether or not this definition is open to many of the same objections brought against the concept of soul as harmony is not pertinent to this discussion.

tions also "the Pythagorean legends" which, he says, imply that any soul can enter into any body. This has generally been taken to refer to the theory of metempsychosis, although Aristotle does not say anything that requires this interpretation, and Rathmann (*op. cit.*, p. 18) recently has denied that the passage offers support for ascribing the doctrine to the Pythagoreans. There is even doubt that the passage refers to this part of Platonic doctrine, for Aristotle's criticism is that no reason is given by "these thinkers" for the entrance of a particular soul into a particular body and this certainly is not true of Plato's accounts of the way in which the choice of the body is made after the first life; it might refer with more justice, however, to the account of the original embodiment of souls in the *Timaeus* (cf. *De Anima* 407 B 15: *συνάπτουσι γὰρ καὶ τιθέασιν εἰς σῶμα τὴν ψυχὴν* and *Timaeus* 43 A: *τὰς τῆς ἀθανάτου ψυχῆς περιόδους ἐνέδουν εἰς ἐπίρρυτον σῶμα καὶ ἀπόρρυτον*).

## CHAPTER FIVE

## EMPIRICAL ARGUMENTS

Although in criticizing the theories of the Presocratics Aristotle frequently uses arguments from observation and experiment, he subordinates such arguments to the theoretical objections derived from his own philosophical system. In that system itself the physical doctrines depend ultimately upon the law of natural motion which was, in turn, derived from observation and experiment, however inaccurate and mistaken; and so the physics of Aristotle may justly be called, in its fundamentals at least, an empirical science, while many of his objections to earlier physical theories also depend upon this empirical law. In most cases, however, even when observations or experiments are mentioned the refutation does not rest upon the observations themselves but upon theoretical principles to which they are, often with great violence, subordinated. Good examples of this procedure have already been noted in the biological discussions where Aristotle's acute skill as an observer is frequently vitiated by his belief that all natural occurrences must somehow comply with his philosophical axioms and by his over-zealous polemic against earlier thinkers generally. The observation that in intercourse the female discharges into the pro-uterine cavity was correct; in itself, however, it was no refutation of the notion that the female contributes seed to the offspring. The criticism of Aristotle depends in that case on his thesis that "Nature does nothing superfluous,"<sup>1</sup> an axiom which cannot be fruitful of objective results since the interpretation of "superfluous" must rest with Aristotle himself. His remarks concerning intestinal worms<sup>2</sup> are equally illuminating of the fashion in which he used observed facts in refuting earlier theories. The use of arguments from observation alone is comparatively rare; but the refutations so constructed are entitled to separate treatment. They are, as might have been

<sup>1</sup> Cf. page 271 *supra*.

<sup>2</sup> Cf. pages 266-267 *supra*.



expected, restricted to certain astronomical, meteorological, and biological doctrines.

Comets Aristotle believed to be a meteorological rather than an astronomical phenomenon; but the earlier theories which treated them as astronomical are criticized not on this basis but simply for assuming characteristics inconsistent with the observed occurrences.<sup>3</sup> Anaxagoras and Democritus said that a comet is the mere appearance due to several planets which approach so near to one another as to seem to merge into a single body.<sup>4</sup> Some of the Pythagoreans said that there is just one comet which is, in fact, a planet visible only at rare intervals, like the planet Mercury, because its elevation above the horizon is very small. This was also the theory of Hippocrates of Chios<sup>5</sup> and his pupil Aeschylus; but they added that the "tail" is in reality merely a reflection of the sun from the moisture which the planet draws after itself. Although the comet appears in the tropics and further south still, they explained that in the former region there is no moisture to reflect the observer's sight to the sun and consequently no "tail," while in the latter position the segment of the comet's circle above the horizon is so small that there is no reflection. The "tail" appears, then, only when the comet lags behind the sun in the northern hemisphere. Aristotle's objections both general and specific are unrelated to his own theory of comets. The comet cannot be a planet, he insists, because all the planets move in the circle of the zodiac and many comets have been seen outside of this circle; and it cannot be a single body because several comets have frequently been seen at the same time. The theory which makes the "tail" a reflection he meets by saying that, if it were true, the comet ought sometimes to be seen without the "tail" which is never the case; only five planets have been observed and comets have

<sup>3</sup> *Meteorology* 342 B 27-344 A 2.

<sup>4</sup> The "merging" apparently consisted in reflection which caused the appearance of a "tail," the body of the comet being merely one of the planets or stars; cf. Gilbert, *Meteorologische Theorien*, pp. 645-6.

<sup>5</sup> He was known especially for his attempt to "square the circle"; cf. *Soph. Elench.* 171 B 12-16; Simplicius, *Phys.*, 55, 26 ff.

appeared in addition to these five both when all five were above the horizon and when some were invisible because of proximity to the sun. Moreover, it is not true, he says, that a comet appears only in the northern region of the sky when the sun is about the summer solstice, for the great comet coincident with the earthquake and tidal wave in Achaëa appeared in the region of the equator and many comets have appeared toward the south, while in the archonship of Eucles a comet appeared in the north while the sun was near the winter solstice. A common objection to the theory just considered and to that of Anaxagoras and Democritus is the fact that some of the fixed stars get a "tail," a statement supported both by observations of the Egyptians and by Aristotle's own experience of seeing a faint tail of light attached to one of the stars in the hind-quarters of the Dog. Equally damaging to both theories, Aristotle claims, is the observation that all comets seen in his time disappeared above the horizon without setting, fading gradually and leaving no body of one or more stars visible. He cites the comet first mentioned which appeared in the archonship of Asteius. Democritus, however, insisted, he says, that upon the dissolution of comets stars had been seen to remain. If this were so in some cases, Aristotle contends, it ought to be universally so; furthermore, the Egyptians record conjunctions of planets with one another and of planets with fixed stars such as he himself had observed in the case of Jupiter and one of the stars in Gemini in which case no comet had appeared. To this refutation a logical argument based upon observation is added. Since the stars appear to be indivisible points in themselves, the conjunction of two or more of them could not produce the appearance of a greater mass any more than the addition of two *really* indivisible points would produce a *really* greater mass.

The criticism of earlier theories concerning the Milky Way<sup>6</sup> is similarly confined to an account of the points at which those theories contradict observed facts; and here, too, the refutation does not itself depend upon Aristotle's own theory which

<sup>6</sup> *Meteorology* 345 A 13-B 31.

traces the phenomenon to the dry exhalation and so makes it meteorological rather than astronomical. Some of the Pythagoreans had said the Milky Way was the path of some one of the stars that had fallen from their courses when Phaëthon was destroyed; others of this school said that it had once been the path of the sun,<sup>7</sup> as if the region had been inflamed by the sun's motion. Aristotle points out that the circle of the zodiac should on this theory have a similar appearance to that of the Milky Way, since not only the sun but also all the planets move in it, whereas it displays no such character except where it touches the Milky Way. Anaxagoras and Democritus are said to have held that the galaxy is the light of stars which are cut off from the rays of the sun when the latter is under the earth; the light of the other stars is then drowned in that of the sun but the earth's shadow allows the proper light of those in the galaxy to be visible. Aristotle refutes this theory by remarking that, since the sun changes its position, the earth's shadow also changes and consequently the Milky Way ought to appear in correspondingly different parts of the sky, whereas it always retains the same position relative to the constellations. Furthermore, if the sun is larger than the earth and the distance of the stars from the earth is many times greater than that of the sun from the earth, the earth's shadow would not reach to the stars at all and so could not protect any of them from the rays of the sun. A third theory is mentioned according to which the galaxy is the reflection of our vision to the sun, a phenomenon similar to that of the comet.<sup>8</sup> Apart from the objection that it is difficult to see how vision can be reflected to the sun during the night (an objection which has little force inasmuch as the reflected light of the moon would present the same difficulty), Aristotle again points out that, since the stars in the galaxy which form the mirror on this theory and the sun which is the

<sup>7</sup> Cf. Achilles, *Isagoge ad Aratum* 24, p. 55, 18 (Maass) = Diels, *Fragmente der Vorsokratiker*, § 29, 10 where this theory is ascribed to Oinopides and connected with the myth of Thyestes.

<sup>8</sup> This marks it as the theory of Hippocrates of Chios; cf. Olympiodorus, *Meteorology*, 68, 30 ff. The mirror in this case is not vapor but the stars themselves.

real object of vision are moving relatively to each other at varying speeds and distances but at speeds and distances which relative to the observer are constant, the part of the mirror illuminated ought also to vary, that is the parts of the galaxy should not remain the same at all times as, in fact, they do.

The objections to previous explanations of the cause and formation of hail Aristotle tries to draw from observed fact also, although his criticism here is rather more affected by certain of his own theories. To the notion that hail is rain-water frozen in the atmosphere above the earth<sup>9</sup> Aristotle objects that water cannot remain suspended in the air nor can it be that tiny drops of moisture suspended because of their small size are frozen and come together to form hail. This can occur in the case of rain; but frozen particles cannot merge into one another.<sup>10</sup> Here Aristotle is intent upon stressing the fact that the freezing is due to a variation of temperature in the atmosphere through which the rain is falling with the result that the cold in the vapor is intensified by the warmth of the lower air stratum into which it falls, the suddenness and intensity of the change according to their degree producing rain or hail. This mechanism is the very opposite of that which Anaxagoras assumed who supposed the cloud to be pushed up into a stratum which is colder than the atmosphere near the earth and there to be congealed.<sup>11</sup> The higher strata he supposed to be colder because the reflection of the sun's rays from the earth have less effect upon them; at the same time these reflections in warm countries and in summer are stronger and propel the clouds higher which explains why hail occurs in summer more than in winter. Aristotle's refutation is concerned with proving that hail is formed near the surface of the earth. He points out that hail occurs most infrequently in very high regions, whereas on this theory it, like snow, ought to be most

<sup>9</sup> Aristotle probably has in mind the description of Plato (*Timaeus* 59 D-E) but the theory is ascribed to Anaximenes (Hippolytus, *Refut.*, I, 7, 7; cf., however, Aëtius, III, 4, 1); of Empedocles we know only vaguely that he thought hail was the result of freezing (cf. [Plutarch], *Stromat.*, 10).

<sup>10</sup> *Meteorology* 348 A 4-14.

<sup>11</sup> *Meteorology* 348 A 14-B 2 and 348 B 12-15.



abundant there, and that great hail-storms are frequently brought by clouds that come very near to the earth's surface. At such times the hail-stones also are very large and not round, for they have not fallen far enough to be diminished in size and turned into spheres; and this shows that the freezing takes place near to the earth's surface.

The treatment of Democritus' and Anaximenes' explanations of earthquakes is briefer and more casual, but it too consists in calling attention to observable facts which Aristotle believes to be at variance with the theories.<sup>12</sup> Democritus, according to Aristotle, supposed that the rain water seeps into the hollows of the earth which already contain water and the movement of the superfluous water in redistributing itself in the caverns then causes the quaking.<sup>13</sup> Anaximenes supposed that the moistening and drying of the earth cause the earth to crack and parts of it then to collapse with the resulting shaking of the earth.<sup>14</sup> This theory implies that the earth in many places is sinking which appears not to be the case; and, further, it fails to explain why in certain regions which display no more moisture or dessication than others earthquakes are very frequent. In general, Aristotle complains, these theories imply that earthquakes are steadily becoming rarer and finally must cease when the earth becomes tightly packed. Such an eventuality he believes to be impossible; and in this belief, while he may be thinking of the fact that earthquakes were no rarer in his own day than previously, he is certainly referring to his principle of the eternity of the world and all of its contemporaneous alterations.<sup>15</sup>

It is very probable that Aristotle attempted to correct earlier theories concerning the inundation and source of the Nile by an appeal to explorations of the upper course of the river; there is even a tradition that he prevailed upon Alexander the Great

<sup>12</sup> *Meteorology* 365 B 1-20. For the criticism of Anaxagoras' theory which immediately precedes this passage see pages 207-209 *supra*.

<sup>13</sup> It is possible that wind also played a part in this theory; cf. Gilbert, *op. cit.*, pp. 302-303.

<sup>14</sup> For the various stages of the process cf. Gilbert, *op. cit.*, pp. 296-298.

<sup>15</sup> Cf. page 137, note 553 *supra*.

to send an expedition up the Nile for this purpose. His arguments against Presocratic explanations of this much discussed problem, however, cannot be safely reconstructed from the pretended fragments of his book on the Nile.<sup>16</sup>

In criticizing earlier descriptions of animals Aristotle is not always in the right, but his insistence upon careful observation enabled him at times to correct earlier mistakes. So he says that the statement of Herodorus the father of Bryson that vultures did not breed in Greece but migrated from some unknown land was based upon the belief that no one had ever seen a vulture's brood; Aristotle, however, claims that the nest is hard to find because it is built upon inaccessible rocks but that it has nevertheless been observed.<sup>17</sup> On the other hand, he himself insists that most birds of prey or taloned birds drink no water at all, presumably because he had not observed them drinking; and he criticizes Hesiod for representing an eagle as drinking.<sup>18</sup> He also opposes the "ancient notion" that the elephant cannot bend its legs,<sup>19</sup> denies that Alcmaeon was right in saying that goats breathe through their ears,<sup>20</sup> and objects to Democritus' statement that spiders secrete the silk of their webs from the interior of their bodies, believing that the silken thread is part of the external covering of the body analogous to the spines of the porcupine.<sup>21</sup> In the last case the observa-

<sup>16</sup> Cf. the passages collected as Aristotle's *fragments* 246 and 247. On the Latin translation which bears the name *Liber Aristotelis de inundatione Nili* (fragment 248) cf. Diels, *Doxographi Graeci*, pp. 226-229.

<sup>17</sup> *Hist. Animal.* 563 A 5-11.

<sup>18</sup> *Hist. Animal.* 601 A 31-B 3 (one manuscript reads Herodotus for Hesiod; Scotus has Homer. The reference is unknown); cf. *Hist. Animal.* 593 B 28-594 A 3 where the kite is said to have been observed drinking.

<sup>19</sup> *De Incessu Animal.* 709 A 8-10, *Hist. Animal.* 498 A 8-13; in *De Part. Animal.* 659 A 25-29, however, he implies that the elephant cannot bend its forelegs. The "earlier notion" is possibly a reference to Ktesias; cf. *De Gen. Animal.* 736 A 2-4.

<sup>20</sup> *Hist. Animal.* 492 A 13-15. Hartung in his edition of White's *Natural History of Selborne*, page 52, note 1, conjectures that the post-auditory sinuses of the chamois with their openings behind the base of the ears may have given rise to the notion here ascribed to Alcmaeon.

<sup>21</sup> *Hist. Animal.* 623 A 30-33. The authenticity of Book IX, in which this passage occurs, is doubtful.



tion of Aristotle was less acute than that of Democritus; probably Aristotle was misled by his terminology which caused him to suppose that there could be no "superfluous" matter in the form of a secretion immediately upon the birth of an animal.

As an introduction to his own description of the vascular system Aristotle outlines the accounts given by Syennesis of Cyprus, Diogenes of Apollonia, and Polybus and refers to others who gave no detailed account of the blood-vessels but agreed in making their origin the head or brain.<sup>22</sup> The details of the various accounts need not be given here, for Aristotle does not criticize them except in so far as he excuses their mistakes by remarking that the reason for them is the difficulty of observing the course of the vessels. In dead bodies the veins collapse as the blood leaves them<sup>23</sup> and so are hard to find; some evidently tried to trace them in living men who were very lean, but the fact that much of their course is in the interior of the body makes this method unsatisfactory. Aristotle himself advises the use of animals that have first been starved and then strangled to death. His own description contains errors due to the difficulty of observation and the inadequacy of his instruments<sup>24</sup> and also to the fact that in the case of the human body he probably proceeded by reasoning analogically from the structure of lower animals.<sup>25</sup> Aristotle makes much of his contention that the heart is the origin and principle of the blood-vessels, a doctrine in which he was anticipated by Plato;<sup>26</sup> Littré admits that in the Hippocratic writings earlier than Aristotle there is nothing to con-

<sup>22</sup> *Hist. Animal.* 511 B 10-513 A 15; cf. Littré, *Oeuvres d'Hippocrate*, I, pp. 220-221; IX, pp. 162-165; and IX, p. 174 (the arrangement of Syennesis); VI, pp. 58-60; and IX, pp. 174-176 (the arrangement of Polybus).

<sup>23</sup> In *Hist. Animal.* 496 B 4-6 Aristotle says that those who believe the lungs are bloodless have been deceived by the fact that when these organs have been removed in dissection the blood has already left them. The reference is to Plato, *Timaeus* 70 C.

<sup>24</sup> For a full account of Aristotle's description and its errors see Lones, *Aristotle's Researches in Natural Science*, pp. 136-147.

<sup>25</sup> On Aristotle's dissections see Lones, *op. cit.*, pp. 102-106.

<sup>26</sup> Cf. *Timaeus* 70 A-B.

trovert the statement that earlier physiologists had supposed the origin of the vascular system to be in the head but he calls attention to the fact that in the description of Diogenes neither the head nor the heart is so treated, the origin of all the other vessels being the two great vessels which extend along the spine on either side. Aristotle's reasons for preferring the heart to the head as the origin of the veins are based upon certain observations; but in employing these facts to refute the rival theory he assumes the validity of various theoretical hypotheses concerning the nature of the origin or first principle of a natural organ.<sup>27</sup> So he objects that those who make the veins originate in the head make the origin multiple and divided and suppose that the blood which in its natural state is warm derives from a region which is naturally cold. His chief argument, however, is that the heart alone of the internal organs is a direct container of blood whereas through all the others the blood is conveyed by vessels, which fact he takes to be proof that the heart is a part of the blood-vessels and their origin. Furthermore, the heart which he believed to be the first organ to be articulated in sanguineous embryos, is full of blood and endowed with motion from its earliest development, a sign that it is the source of the nature of sanguineous animals. The supposed observation, also, that the efferent and afferent motions of feeling and sensation center in the heart, added to the theoretical reasoning that the approximate center of the body would be the most efficient position for the principle of life which as a principle ought if possible to be unique, seemed to Aristotle to preclude the possibility that the brain or any part of the head should be the origin of what for sanguineous animals is the essence of their life, namely the blood. The fact that neither the blood nor any part of the body without blood is sensitive was plausible evidence that the one organ which is the direct container of blood should itself be the principle; and support for this contention was found in the observation that all sanguineous animals possess a heart.<sup>28</sup>

<sup>27</sup> *De Part. Animal.* 665 B 27-666 B 1.

<sup>28</sup> All possess a liver also; but this organ cannot be the principle of the blood



Various fantastic notions concerning sexual characteristics are also refuted by appealing to observation. Aristotle mentions a belief that all fish except the cartilaginous species are female, the so-called males differing from the other females only in being sterile as the caprifig differs from the fig;<sup>29</sup> he answers this theory by pointing out that the male oviparous fish has spermatogenic passages and sperm while the female has a uterus, whereas if the theory were correct the unproductive fish should also have a uterus though different from the uterus of the productive female. The mistaken theory, Aristotle believes, arose from the observation that animals which copulate produce few young in comparison with oviparous fish; these theorists failed to notice that the fish in question, however, produce imperfect eggs which complete their growth outside of the body. Moreover, cephalopods and crustacea also produce many eggs; yet they have been observed in copulation and obviously differ in sex.<sup>30</sup> The story widely believed and told by Herodotus among others, that the female fish conceives by swallowing the sperm of the male Aristotle shows to be inconsistent with observable facts.<sup>31</sup> The development and emission of eggs and milt take place at the same time, neither the roe nor the milt being discharged all at once, and the milt is discharged upon the eggs once they are laid. In order that the eggs may be fertile, however, Aristotle believed that copulation must have preceded the development in the female;<sup>32</sup> but that sperm which is swallowed cannot possibly impregnate the female is obvious, he says, from the fact that the passage from the mouth leads not to the uterus but to the stomach where the entering substance would be digested. This fact is

or the whole body, since it does not contain blood *directly*, a blood vessel enters it but none proceeds from it, and its position is not suitable.

<sup>29</sup> *De Gen. Animal.* 755 B 7-756 A 5.

<sup>30</sup> Aristotle himself recognized some fish to be hermaphrodite (cf. *De Gen. Animal.* 741 A 32 ff., 755 B 20-21; *Hist. Animal.* 538 A 19-21).

<sup>31</sup> *De Gen. Animal.* 756 A 5-B 14. Cf. Herodotus, II, 93.

<sup>32</sup> The mechanism of sprinkling the eggs with milt after oviposition Aristotle describes correctly but supposes the purpose to be the preservation of the eggs. All fish that have difference of sex he thought copulated, and he even says that the process had been observed.

also complete refutation of the notion expressed by Anaxagoras and some other physical philosophers that the raven and ibis have intercourse with their mouths and that the weasel gives birth at the mouth.<sup>33</sup> The habit of ravens to join their beaks and the fact that this bird is seldom seen in the act of copulation gave rise to the story, although it has a uterus like other birds and eggs are found in it near the diaphragm. The weasel, too, has a uterus like other quadrupeds and no outlet from it to the mouth; the story concerning this animal, Aristotle says, arose simply from the fact that it often carries its young in its mouth.

The common story that the hyaena has both male and female pudenda and the similar report of Herodorus the Heracleot about the badger with the theory that the badger impregnates itself and the hyaena acts as male and female in alternate years Aristotle calls pure fiction having its basis in the fact that both male and female hyaenas have a line similar in appearance to the female pudenda under the tail; the observation of males, which are more frequently caught than females, gave rise to the story.<sup>34</sup>

Aristotle believed that all semen is liquid and white, doubtless from observation; but he explained these characteristics as due to the nature of water and πνεῦμα which he supposed to be the constituents of semen. Consequently when he asserts that Ktesias was mistaken in saying that the semen of elephants when dried becomes hard so that it appears to be amber<sup>35</sup> and that Herodotus was equally wrong in saying that the semen of Ethiopians is black,<sup>36</sup> although his remarks may be based upon observation in these particular cases, the universal nature of the statement depends upon his theory of the ingredients of the secretion.

<sup>33</sup> *De Gen. Animal.* 756 B 13-757 A 2.

<sup>34</sup> *De Gen. Animal.* 757 A 2-12.

<sup>35</sup> *De Gen. Animal.* 736 A 2-5.

<sup>36</sup> *De Gen. Animal.* 736 A 10-13 where he adds that Herodotus thought that everything about a black man must be black, although he must have seen that the teeth of blacks are white; and *Hist. Animal.* 523 A 17-20 where, however, he himself says that after emission semen becomes thin and black. Cf. Herodotus, III, 101.

The theory that wind-eggs have no proper origin but are merely the remnants of a previous copulation Aristotle claims is refuted by the observation that they have been produced by chickens and goslings before any copulation has occurred; the theory, he says, was due to misinterpretation of the fact that once hens have been trodden they continue to have eggs without intermission.<sup>37</sup> He also maintains that Alcmaeon was wrong in asserting that the white of the egg is the nourishment of the chick; his own belief is that the yolk serves this purpose and that Alcmaeon's theory, which seems to have been the common belief, was due merely to the similarity of the color of the white to that of milk.<sup>38</sup> The theory that children are nourished in the womb by sucking a piece of flesh<sup>39</sup> is proved to be false, Aristotle says, by the fact that dissection shows no such thing in other animals, although the same mechanism should be found in them as in human beings. Besides, all embryos are separated from the uterus and the fluids therein by membranes within which there are no such pieces of flesh; and the fact that all animals produced from eggs develop apart from the mother indicates that the nourishment is not carried on in this fashion.

The number of cases in which Aristotle tests Presocratic doctrine by the empirical method alone is obviously very limited; in no case is a really important theory concerned. Even here, however, Aristotle's observations are not always improvements of those made by his predecessors.

<sup>37</sup> *De Gen. Animal.* 751 A 9-13.

<sup>38</sup> *De Gen. Animal.* 752 B 22-28. For the theory of Alcmaeon cf. Hippocrates, *περὶ φύσιος παιδίου*, § 30 (Littré, VII, p. 536).

<sup>39</sup> *De Gen. Animal.* 746 A 19-28. This notion is ascribed to Democritus in Aëtius, V, 16, 1 (cf. page 288, note 255 *supra*), but Censorinus (*De Die Natali*, 6) gives it as that of Diogenes and Hippo and this ascription appears to be supported so far as Diogenes is concerned by Aristotle, *fragment* 285, 12 (page 222, lines 21-23, Rose). The theory appears also in the Hippocratic treatise *περὶ σαρκῶν*, § 6 (Littré, VIII, p. 592).

## CHAPTER SIX

## QUOTATIONS AND ACCOMMODATIONS

The remaining references to the Presocratics are only incidentally critical; but they shed the clearer light upon Aristotle's attitude toward these thinkers because they are casual and they demonstrate in an uncontroversial manner his tendency to accommodate to his own doctrines every possible early statement by a reinterpretation of its obvious meaning. One group of these references consists of citations by which he attempts to exemplify the subjects under discussion and which consequently amount to tacitly implied criticism of the doctrines or arguments cited. Such criticism is more than usually direct in the citation of Empedocles as an example of authors who cloak the emptiness of their thought in ambiguous and pompous phraseology<sup>1</sup> and of the writings of Heraclitus to exemplify sentences which are obscure because they are difficult to punctuate.<sup>2</sup> Heraclitus himself is cited as an example to support Aristotle's contention against the Academy that knowledge does not surpass opinion in the force of conviction it arouses in a man;<sup>3</sup> in this case it is implied that both Aristotle and his adversaries hold the opinion of Heraclitus to be false. The doctrine of Heraclitus that "everything is in motion" and of Melissus that "Being is one" are cited as examples of the paradoxical thesis,<sup>4</sup> while Zeno's argument for the identification of all things is supposed to exemplify the case in which

<sup>1</sup> *Rhetoric* 1407 A 33-37. Cf. *Poetics* 1447 B 17-20 where Aristotle says that only the metrical form is common to Homer and Empedocles, for the latter is rather a physical philosopher than a poet, although in the dialogue *περὶ ποιητῶν* he is supposed to have said that Empedocles was 'Ομηρικὸς . . . καὶ δεινὸς περὶ τὴν φράσιν (Diogenes Laertius, VIII, 57 = Aristotle, *fragment* 70). Cf. Gudeman, *Aristoteles Poetik*, pp. 92-94.

<sup>2</sup> *Rhetoric* 1407 B 12-18. He quotes the sentence, τοῦ λόγου τοῦ δ' ἐόντος δὲ δέξυνετο ἄνθρωποι γίγνονται, saying that it is not clear whether δὲ is to be taken with what precedes or with what follows it. This remark has given rise to two schools of interpretation concerning which see W. Capelle, *Hermes*, LIX (1924), pp. 190-203 and Burnet, *E. G. P.*, p. 133, n. 1.

<sup>3</sup> *Nicomachean Ethics* 1146 B 29-31.

<sup>4</sup> *Topics* 104 B 21-22.



ambiguous terms (i. e. Being and Unity) are treated as unambiguous.<sup>5</sup> The quadrature of the circle as demonstrated by Hippocrates of Chios is given as an example of a pseudographema and contrasted with the methods of Bryson and Antiphon which Aristotle calls merely eristic;<sup>6</sup> this distinction with respect to the present examples shows Aristotle's lack of feeling for mathematical reasoning, since the work of Antiphon and Bryson was pioneering in the method of exhaustion which later proved to be so fruitful.

From Epicharmus a line is quoted as an example of false antithesis<sup>7</sup> and another to show the use of the preposition 'εκ to designate the efficient cause.<sup>8</sup> A couplet of Empedocles against the slaughter of living creatures is quoted as expressing what Aristotle means by a common or natural law,<sup>9</sup> a saying of Protarchus to illustrate the metaphorical use of "fortunate" and "unfortunate,"<sup>10</sup> a pun of Gorgias concerning the arbitrary methods of defining citizenship in certain cities,<sup>11</sup> and a statement of Protagoras to illustrate the possibility of

<sup>5</sup> *Soph. Elench.* 170 B 19-25. The reference is probably to the argument read by Zeno and summarized by Socrates in the *Parmenides* 127 E. In *Topics* 112 B 21-26 in warning against the fallacy which results from treating synonyms as distinct in meaning and so making a thing an accident of itself Aristotle mentions Prodicus' distinction of ἡδοναί as χαρά, τέρψις, and εὐφροσύνη. Cf. Plato, *Protagoras* 337 C and Xenophon, *Memorabilia*, II, 1, 24.

<sup>6</sup> *Soph. Elench.* 171 B 12-18, 172 A 2-7. In *Physics* 185 A 14-17 the methods are contrasted as an example of the statement that one has to refute only such false demonstrations as proceed from the principles of the science under consideration. On these various methods of quadrature and Aristotle's judgment of them see Heath, *A Manual of Greek Mathematics*, pp. 122-131, 140-142.

<sup>7</sup> *Rhetoric* 1410 B 3-5: τόκα μὲν ἐν τήνων ἐγών ἦν τόκα δὲ παρὰ τήνοισ ἐγών. It is quoted also by Demetrius (*De Eloc.* § 24) with ἐν τήνοισ instead of ἐν τήνων; Demetrius says that Epicharmus meant the line to be a travesty on rhetoricians.

<sup>8</sup> *De Gen. Animal.* 724 A 28-30. Epicharmus is quoted in *Metaphysics* 1086 A 17-18, also, in support of the notion that a good speech cannot be made of poor material. Diels assigns the verses in *Rhetoric* 1394 B 13 and 1394 B 24-25 to Epicharmus, although Aristotle does not name the author.

<sup>9</sup> *Rhetoric* 1373 B 16-19; cf. Empedocles, *fragment* 135.

<sup>10</sup> *Physics* 197 B 8-11.

<sup>11</sup> *Politics* 1275 B 26-30.

apparent but unreal and of real but unapparent solecism.<sup>12</sup> Two apophthegms of Xenophanes on religion<sup>13</sup> are cited as examples of rhetorical topics and one on the justice of administering oaths.<sup>14</sup> To illustrate his statement that error is possible only in the case of a combination of notions to form a unity Aristotle refers to the line of Empedocles which speaks of the growth of neckless heads and compares the composition of ideas to the process of combination which Empedocles supposed the force of "Love" brought about.<sup>15</sup> When he is saying that a knowledge of grammatical theory is no part of the poet's business, he refers to a captious criticism of Homer made by Protagoras who said that Homer addressed a command to the goddess when he meant to pray to her, for the opening sentence of the *Iliad* is in the imperative mood.<sup>16</sup>

There are some interesting examples of Aristotle's use of one predecessor's doctrine to combat that of another. So in his attack upon the theory of ideas he sets forth the difficulties inherent in the postulate of entities intermediate between ideas and sensible objects and then denies that mensuration and astronomy as contrasted with geometry deal with perceptible magnitudes, since Protagoras in his refutation of the geometers was right, so far as sensible circles and lines are concerned, in saying that the circle touches the line not at a point but along a line.<sup>17</sup> Again he uses against the Platonic doctrine of substantial Being the argument of Parmenides that, since what is other than Being cannot be, all things must be one; so he argues that the Platonists cannot hold to substantial Being and at the same time to a plurality of existences.<sup>18</sup> Similarly

<sup>12</sup> *Soph. Elench.* 173 B 17-22; cf. Zeller-Nestle, *op. cit.*, I, p. 1383, n. 1, p. 1417, n. 2.

<sup>13</sup> *Rhetoric* 1399 B 6-8, 1400 B 5-8 (cf. Plutarch, *Moralia*, 171 E, 379 B-C, 763 D).

<sup>14</sup> *Rhetoric* 1377 A 19-21.

<sup>15</sup> *De Anima* 430 A 27-31; cf. Empedocles, *fragment* 57 (Aristotle writes πολλῶν μὲν κόρσαι instead of πολλαὶ μὲν κόρσαι).

<sup>16</sup> *Poetics* 1456 B 15-17; cf. Gudeman, *Aristoteles Poetik*, pp. 335-6.

<sup>17</sup> *Metaphysics* 998 A 1-4.

<sup>18</sup> *Metaphysics* 1001 A 31-B 1. Ross points out that Aristotle neglects the fact that for the Platonists τὸ ὄν meant the attribute of existence and not "what is,"

he attempts to use an argument from Zeno in his attack upon substantial unity, although he rejects Zeno's argument in the end because he misunderstands its purport;<sup>19</sup> the same tendency appears in a passage where, in order to mark more vehemently his disagreement with the Socratic thesis of the unity of virtue, Aristotle goes so far as to say that those who enumerate the various virtues as Gorgias did come nearer to the truth than those who give one of the Socratic definitions.<sup>20</sup>

The largest and most important group of the quotations and citations from the Presocratics is that which illustrates Aristotle's penchant for finding in the casual remarks of his predecessors support for his own doctrines. This is something more than a rhetorical device, since he believed with apparent sincerity that the fundamentals of his system were vaguely and with confusion recognized by previous thinkers. It is significant, however, that he uses in this manner opinions of those schools even with which he most violently disagrees. In his attempt to prove that there are only three spatial dimensions he appeals to the Pythagorean proverb that the universe and all things in it are determined by the triad, although this remark obviously had nothing to do with dimensions.<sup>21</sup> The old pro-

as it did for Parmenides. Consequently they can consistently hypostatize the abstraction without surrendering the plurality of things that exist. Cf. Aristotle's assertion that the Pythagorean representation of Unity as one of the categories in the column of goods is preferable to the Platonic notion of a single idea of Good (*Nicomachean Ethics* 1096 B 5-6; page 241, note 111 *supra*). In *Metaphysics* 1039 A 8-11 he uses Democritus' axiom that one thing cannot come to be from two or two things from one as an argument against the substantiality of common predicates, equating the statement of Democritus with his own conclusion that a substance cannot consist of substances actually present. This he does by saying that for Democritus the atomic magnitudes are substances; and therewith he reads into the physical doctrine of Atomism his own metaphysical principles.

<sup>19</sup> *Metaphysics* 1001 B 7-16; cf. page 43, note 165 *supra*.

<sup>20</sup> *Politics* 1260 A 24-28; cf. Plato, *Meno* 71 D-73 C.

<sup>21</sup> *De Caelo* 268 A 10-13. The reasoning of the Pythagoreans is apparently represented by Aristotle's statement that the beginning, middle, and end embrace the number of the universe and these are equivalent to the number of the triad. Simplicius (*De Caelo*, 9, 10-11) expresses astonishment that Aristotle should use a Pythagorean formula in his demonstration. In *De Caelo* 286 B 27-30, arguing that the sphere is the primary solid, Aristotle appeals for support to those who

verb of "like to like" which had become a philosophical axiom he attempts to interpret as a cryptical statement of his own theory of natural motion which represented the movement of a body to its proper place as the realization of its own form.<sup>22</sup> Even more extreme is Aristotle's use of an astronomical theory which he himself discards to support a geographical doctrine of his own. He maintains that the general flow of waters on the earth is from the north because of the high mountains in that region; and as an indication of the truth of his assumption of this height in the north he cites the ancient theory that explained night by supposing that the sun travelled around the earth, not under it, and was hidden during part of its course by the lofty mountains in the northern part of the earth's disc.<sup>23</sup> The ancient notion of the river of Ocean encircling the earth Aristotle suggests may have been merely a metaphorical way of expressing the continuous cycle of change in which the water from the earth's surface is drawn up as vapor by the sun and changing again to water falls as rain.<sup>24</sup>

The notion that fire is fed by the other simple bodies or, as Aristotle puts it importing his own doctrine of alteration into the older theory, that in the process of generation of the simple bodies from one another fire alone is nourished, a notion which he attacks elsewhere,<sup>25</sup> he attempts to interpret as his own theory of the relationship of fire to the other elements in organic bodies.<sup>26</sup> It is the vital heat which digests the food and so actualizes its potentiality to be the body; but what is nourished and grows is the embodied form and the form of anything is

analyze solids into planes and construct bodies from planes. They obviously consider the sphere to have a single surface, for it is the only solid which they do not divide. Simplicius (*De Caelo*, 407, 12) calls the people here mentioned φυσικοί and Barthélemy Saint-Hilaire supposes them to have been Ionians. Aristotle refers only to Platonists and Pythagoreans in this fashion, however; nor can any others be meant here.

<sup>22</sup> *De Caelo* 310 A 31-B 2.

<sup>23</sup> *Meteorology* 354 A 27-32. The theory mentioned was that of Anaximenes; cf. Hippolytus, *Refut.*, I, 7, 6 and Aëtius, II, 16, 6.

<sup>24</sup> *Meteorology* 347 A 2-8.

<sup>25</sup> *Meteorology* 354 B 33-355 A 15; cf. pages 133 f. *supra*.

<sup>26</sup> *De Generatione* 335 A 14-21.



in its limits.<sup>27</sup> Fire, however, naturally moves to the periphery, so that fire may be said to be the form and in this sense to be nourished by the other simple bodies. Not only does Aristotle here try to reconcile with his own doctrine a theory which he elsewhere condemns but in so doing he develops as his own a principle which he attacks in another work as absurd.<sup>28</sup> As concurring witness for the statement that the moist is the element that lends definite shape to the dry so that a body with a definite shape must contain these two elements which act as a glue one to the other Empedocles is quoted as having said "gluing barley-meal with water";<sup>29</sup> another line of his poem is quoted to support Aristotle's statement that the seed of plants is analogous to the egg of oviparous animals;<sup>30</sup> and a third quotation serves Aristotle in his contention that bones, hair, and such things are analogous growths which consist of similar material.<sup>31</sup>

The Orphic verse which likens the articulation of the growing embryo to the knitting of a net is cited as an expression of the theory of development which Aristotle espouses;<sup>32</sup> and Alcmaeon's remark concerning the flowering of plants that are about to bear seed is mentioned in connection with the statement that the appearance of sperm in the male is marked by the growth of pubic hair.<sup>33</sup> The notion that men and quadrupeds

<sup>27</sup> This notion is, however, attacked in *De Part. Animal.* 640 B 29 ff. where Aristotle claims to have found it expressed by Democritus; cf. page 259 *supra*. Cf., however, the use of the spatial limit as form in *De Caelo* 310 B 7-11.

<sup>28</sup> *De Anima* 416 A 9-18 (cf. page 312 *supra*). Although Gilbert (*Meteorologische Theorien* etc., p. 443, n. 1) gives the opinion τὸν ἥλιον τρέφεσθαι τῷ ὑγρῷ as common to "most of the old physical philosophers," Aristotle probably has here chiefly Heraclitus and his followers in mind (cf. pages 312, note 82 and 133, note 541 *supra*).

<sup>29</sup> *Meteorology* 381 B 31-382 A 2.

<sup>30</sup> *De Gen. Animal.* 731 A 1-9; Empedocles, *fragment* 79.

<sup>31</sup> *Meteorology* 387 A 32-B 6. The lines of Empedocles say that hair, leaves, wings, and scales are all the same thing.

<sup>32</sup> *De Gen. Animal.* 734 A 16-21. The alternative theory, the simultaneous formation of all the parts, is espoused in Hippocrates, *περὶ διατρῆς*, § 26 (Littré, VI, p. 498).

<sup>33</sup> *Hist. Animal.* 581 A 11-17.

may have sprung from the earth originally<sup>34</sup> Aristotle recasts into his own theory of spontaneous generation, saying that, if the notion contains any truth, it can only mean that the animals developed from scoleces which had been spontaneously generated in the manner of earthworms.<sup>35</sup> To corroborate his statement that wild boars when castrated become larger and fiercer he quotes two lines from Homer which, to judge by our texts, he contaminated curiously but which, apart from that possibility, do not bear the meaning Aristotle gave to them.<sup>36</sup>

The Pythagorean assignment of evil to the unlimited and good to the limited is reinterpreted as his own doctrine that, since there are many possibilities of error but only a single "right way," the good must be a mean.<sup>37</sup> The apophthegm of Heraclitus that it is hard to fight against the heart's desire, is twice cited. In both cases Aristotle misinterprets the saying, taking θυμός in the sense of "anger"; in one passage<sup>38</sup> he uses the quotation to support his thesis that people who attack a ruler in anger because they consider themselves to have been insulted are particularly dangerous, in the other<sup>39</sup> to point his contention that pleasure is a more difficult foe than pain. Remarks of both Solon and Anaxagoras are adduced by Aristotle as corroborative testimony for his judgment that great external resources are not necessary for happiness.<sup>40</sup>

His theory that the husband-wife, master-slave relationships

<sup>34</sup> Aristotle probably means to include both the myths of earth-born men and such theories as that of Anaximander (Aëtius, V, 19, 4; Hippolytus, *Refut.*, I, 6, 6; Plutarch, *Quaest. Conviv.* 730 E-F; Censorinus, *De Die Natali*, IV, 7).

<sup>35</sup> *De Gen. Animal.* 762 B 28-763 A 7.

<sup>36</sup> *Hist. Animal.* 578 A 32-B 2. Aristotle quotes θρέψεν ἐπὶ χλοῦνῃ σὺν ἄγριον. οὐδὲ ἐφκει | θηρὶ γε σιτοφάγῳ ἀλλὰ ρίῳ ὑλήεντι. The first sentence (with ὥρσεν for θρέψεν) appears in *Iliad*, IX, 539, the second (with ἀνδρὶ for Aristotle's θηρὶ) in *Odyssey*, IX, 190-191. Leaf supposes that the contamination may have been present in popular copies of the *Iliad*. However that may be, χλοῦνης did not mean "castrated" in Homer.

<sup>37</sup> *Nicomachean Ethics* 1106 B 28-34.

<sup>38</sup> *Politics* 1315 A 29-31. Cf. Heraclitus, *fragment* 85; cf. Zeller-Nestle, *op. cit.*, I, p. 912, n. 4; Burnet, *E. G. P.*, p. 140, n. 2.

<sup>39</sup> *Nicomachean Ethics* 1105 A 7-9; cf. *Eudemian Ethics* 1223 B 18-24.

<sup>40</sup> *Nicomachean Ethics* 1179 A 9-16. Cf. *Eudemian Ethics* 1215 B 6-14 and Diogenes Laertius, II, 7 for Anaxagoras, Herodotus, I, 30-32 for Solon.

are primitive and primary social forms he pretends to find in a line of Hesiod, although he has to wrench the original meaning of the passage in the process.<sup>41</sup> Similarly by a misinterpretation of ἀτίμητον he discovers that Homer agreed with his doctrine that the distinctive mark of citizenship is the right to hold state office.<sup>42</sup> Perhaps the most striking and violent reinterpretation of the straightforward meaning of a passage, however, occurs in his discussion of the terms "many" and "few"; there he objects that Anaxagoras instead of saying "all things were together limitless in multitude and smallness" should have said "in multitude and fewness." If he had so expressed himself Aristotle points out that the statement would have been obviously false since things cannot be infinitely few.<sup>43</sup> Anaxagoras clearly meant that things are infinitely many and infinitely small since there is no limit to the divisibility of anything; but Aristotle arbitrarily supposed that ἄπειρα καὶ πλήθει καὶ μικρότητι must express an opposition equivalent to the common πλήθει καὶ ὀλιγότητι which is merely a way of saying "numerically."<sup>44</sup> Without regard for the context, then, he proposed to reinterpret the phrase and thereby to show that the fundamental axiom of Anaxagoras was absurd; if Anaxagoras had expressed the opposition inherent in the concept of number, he means, it would have been apparent at once that things can not be called numerically infinite.<sup>45</sup>

<sup>41</sup> *Politics* 1252 B 9-12; Hesiod, *Works and Days*, 405. The interpolator of line 406 took γυναῖκα to mean a female slave not a wife as Aristotle interpreted it. But Aristotle's attempt to find in the line his two primary relationships and the consequent interpretation of βούς as the analogue of servant in the poor man's homestead supply a motive for his interpretation of γυναῖκα which casts doubt upon the validity of that interpretation. This doubt is strengthened by his construction of γυναῖκά τε βούν τ' ἀροτῆρα as explanatory predicates of οἶκον whereas they are parallel objects of ποιήσασθαι (or, possibly, in apposition to χρεῖων τε λύσιν λιμοῦ τ' ἀλεωρήν).

<sup>42</sup> *Politics* 1278 A 35-38, cf. *Iliad* IX 648 where ἀτίμητον means one whose murder has not to be recompensed by payment of a blood-price, not, as Aristotle takes it, one who has been excluded from the right of holding office.

<sup>43</sup> *Metaphysics* 1056 B 28-32.

<sup>44</sup> Cf. Heidel's note in *Archiv für Geschichte der Philosophie*, XIX (1906), p. 366, n. 107.

<sup>45</sup> Cf. Bowman in *Classical Review*, XXX (1916), pp. 42-44.

## CHAPTER SEVEN

### ARISTOTLE AND THE HISTORY OF PRESOCRATIC PHILOSOPHY

When Aristotle's references to Presocratic philosophy have been read in their contexts and when these references and criticisms have been studied as integral parts of the positive arguments in which they are set, it becomes clear that one cannot safely wrench them away to use as building-blocks for a history of Presocratic philosophy. There are no "doxographical" accounts in the works of Aristotle, because Aristotle was not a doxographer but a philosopher seeking to construct a complete and final philosophy. For him—as for every philosopher—the doctrines of his predecessors were materials to be remoulded for his own purpose; in their new form they can be of use to the historian of philosophy only if Aristotle's process of interpretation can be reversed so as to regenerate them in the form they had before Aristotle employed them as his material. If the Aristotelian corpus were our only source for the philosophy of the Presocratics, this task would be in the majority of cases hopeless. It is, consequently, obvious that after our preceding analysis to proceed straightway to a new interpretation of Presocratic philosophy would be an act of insolence foredoomed to failure; the necessary analysis of all our other sources and, finally, the application of the results of these investigations to the best sources of all, the preserved original fragments, cannot be attempted in this work. This is by way of explanation and warning to those who may be disappointed to find in the following pages no new combinations, no startling revelations of the esoteric meaning of early Greek philosophy. For the history of that period of thought the preceding investigation should yield strictly only negative conclusions; but these are of prime importance for the further steps to a positive description and, if they should hint at some of the reasons for the constant misunderstandings and disagreements among students of Greek philosophy, are not unworthy of attention.



One is bound to wonder first why Aristotle should have concerned himself at all with "ancient doctrines." Refutations of the Platonists, his contemporaries, and of Plato, the source of their systems, one can understand, and concern with the Atomists is liable to the same interpretation; but who was likely to maintain the doctrines of Anaximenes or Anaxagoras? Even the Pythagoreans had disappeared! He felt that all previous theories were "stammering" attempts to express his own system, that the full truth had been discovered and lost many times and all imperfect doctrines represented vague and confused vestiges of this truth (*De Caelo* 270 B 16-20, *Meteorol.* 339 B 27-30, *Politics* 1329 B 25-30); here then lay the material from which by combination and interpretation the shattered pattern of reality could be reintegrated (*Metaphysics* 985 A 4 ff., cf. *Politics* 1264 A 1-5). If his own theories could be shown to have existed, however distorted and indefinite, in the doctrines of earlier thinkers, it was to his mind an additional proof of their validity. This attitude, though often unconscious and never so openly stated, can be paralleled in philosophers of all ages; the havoc it plays for the historian who attempts to use the writings of such a philosopher as evidence for previous systems is obvious. This is but one side of Aristotle's method, however, for, if he tries to twist Presocratic theories into agreement with his own system, he also distorts them in order to set in bold relief the differences that make his doctrine superior. Sometimes the two results follow from a single interpretation. If the precosmical mixture of Anaxagoras answers to Aristotle's prime matter, the separation caused by *voûs* implies that qualities are capable of separate existence; and Anaxagoras is praised for the first tenet and censured for the second, neither of which was his. Elsewhere a theory receives varying stress in order to yield similarity with his own at one time and difference from it at another. The four roots of Empedocles are "developed" from the *Sphere* which shows that they can change into one another, but the *Sphere* results from a combination of the "roots" which implies that the "elements" are prior to "simple matter"; and on the strength of this double twist Empedocles is upbraided for not indicating clearly

whether *Sphere* or "roots" constituted his elementary material. This "aporetic" method is liable to all the disabilities and dangers which Aristotle himself sagaciously indicates as consequences of the tendency to debate rather than investigate (*De Caelo* 294 B 6-13); but it is this tendency itself more than any theory of the unity of human thought that impelled him to adopt the "aporetic" method in his lectures. Aristotle had behind him the tradition of Plato's dialogues and his own early writings and deep within him the Greek predilection for the *ἀγών* (cf. *De Caelo* 279 B 6-12, Simplicius, *ad loc.*, and 294 B 7-10); whether or not the technical writings were consciously intended as an artistic form that would retain the interplay of the Platonic dialogue is of no consequence, for in fact each discussion is a dialogue in which the opinions of earlier thinkers take the place of interlocutors and the conclusion is developed by hypothesis and objection. In that case, however, it appears that the elements introduced are no more randomly chosen than are the opinions expressed by the interlocutors in Plato's dialogues. Each opinion cited is meant to play its part in the development of the conclusion; and, if Aristotle could use only theories that had really been expressed by someone, he still had left to him the device of the dramatists and Plato. He could interpret them howsoever it might suit his purpose. That he did so the preceding chapters have shown in detail; I call attention to but one case here and that one concerned with a crux in the history of philosophy. In three separate places there are given totally different accounts of the origin of the Eleatic doctrine (pages 63, note 258; 95, note 401; 220-221); it may be that all three are partially true or that all are false, but the decisive observation is that each one fits perfectly the argument of which it is a part and was obviously chosen for the purpose of supporting the particular conclusion that Aristotle desires to draw in each several place. Yet by appealing to one or the other of these three statements as evidence for his theory the historian can give totally different explanations of the development and relationships of the early Greek thinkers. In recent years it has been frequently admitted that "Aristotle is not a good his-



torical witness"; but that even those who make this statement seriously believe it I am forced to doubt when, for example, Burnet says as much in his *Note on the Sources* (*E. G. P.*,<sup>3</sup> p. 31) and then admits that the whole thesis of his book rests upon one of the passages to which I have just referred and a statement of Theophrastus which reproduces part of that passage almost *verbatim* (*E. G. P.*,<sup>3</sup> vi). Examples of this procedure could be multiplied; but it is clear that, if statements of Aristotle are the origin of many misapprehensions concerning the Presocratics, the fault is largely chargeable to those who withdraw those statements from their context without considering the purpose for which Aristotle included them and the probable alteration the facts have undergone in being fitted to that purpose. It is not possible by this merely mechanical method of excerpting notices from various parts of Aristotle's writings to construct so much as a consistent scheme of his own conception of Presocratic systems, for there are constant contradictions both in detailed report and in general interpretation; this fact alone forbids the use of any single passage as evidence for the history of earlier doctrines until all the possible reasons for the presence of that passage in his argument have been thoroughly analyzed.

If we were in possession of all the Presocratic writings and so had to use no secondary sources, we could give our attention unreservedly to a study of Aristotle's methods of recasting this material to serve in the construction of his own system. This problem is of great importance for a full comprehension of Aristotle's philosophy itself; and the preceding chapters, I hope, contribute in some degree to its solution; but in this matter the analysis of his criticism of Plato and the Platonists must precede the statement of definite conclusions, although in general it is clear that he sought to establish a synthesis of Presocratic and Platonic philosophy. Since, however, the circumstances force us to make use of Aristotle's reports in our attempt to retrieve earlier systems of thought, we must exercise the greatest care in analyzing his statements, being constantly aware that none can be accepted as historical evidence until it has been compared with all other references in his

writings to the same theory and others similar to it and until from its use in its own context we have attempted to discover the reason for its citation and the probable distortion of it consequent upon this application. In following this method the importance of an analysis of Aristotle's criticism has, I trust, become apparent, for most frequently the criticism determined what doctrines were to be cited and how they were to be stressed and interpreted, just as the positive theory to be advanced determined what sort of criticism should be introduced in order to lead inevitably to the desired conclusion. This is the general scheme of composition, determined by the purpose of the argument and in turn determining the content of the ἀπορίαι. Attention to this canon shows at once the irrelevance of Erich Frank's argument (*Plato und die sogenannten Pythagoreer*, p. 221) that Aristotle must have thought the Pythagoreans followed Democritus chronologically because in *Metaphysics* A, chap. 5 he describes their theory after he has treated that of the Atomists. Apart from the fact that 985 B 23 expressly warns against this interpretation, it is the Eleatic doctrine that follows that of the Pythagoreans in this exposition. Are we therefore to argue that Aristotle thought Democritus was earlier than Xenophanes and Parmenides? The arrangement here was determined by Aristotle's desire to find in the history of previous thought a development from the treatment of all causality as material to a recognition of formal causality; unless this is understood to be the fundamental motivation of the passage, the entire purport must be irretrievably lost. In using this method of analysis we have seen that besides self-contradictions and clear misinterpretations—where we can control these by the original documents—the most flagrant warning offered by the text of Aristotle consists in omissions and these, in general, of two kinds. When, for example, in the *De Anima* Aristotle asserts that the characteristics of the soul had hitherto always been referred to the ultimate principles that each philosopher had chosen to use as the basis of the physical universe and when in citing examples of this procedure he omits all reference to Anaximander while citing the other Ionians, we are justified in suspecting that the



omission was caused by Aristotle's inability so to interpret the doctrine of Anaximander as to make it support his thesis. When, further, we find this same philosopher disregarded in passages that draw general conclusions for all the material monists, we have a right to surmise that for some reason his statements defied employment as evidence for these conclusions; and we must consequently admit as possibilities both that Anaximander himself may not have manifested the characteristics here applied to the whole group and that some of the other doctrines cited as evidence may have required considerable interpretation before they were serviceable for this purpose. The second type of omission which must give us pause is that which we have found at times in passages where Aristotle, trying to attribute a certain doctrine to a particular philosopher, gives a quotation which demonstrably has not the meaning he assigns to it and seeks to twist the words to the end he requires. In such cases it is reasonable to suppose that the passage quoted was the best he could find for his argument; and we must, consequently, be extremely hesitant to follow Aristotle in attributing such a doctrine to the philosopher in question. An example of this type of omission was noted in Aristotle's attempt to find four periods in the cycle of Empedocles (cf. page 175, note 130 *supra*).

We are now in a position to outline the sources of error in Aristotle's reports of Presocratic doctrine; the detailed treatment of the individual passages in the preceding chapters has included separate remarks upon this topic wherever pertinent so that a single reference here will serve to exemplify each type.

1) There is first the class of wilful misrepresentation for the particular purpose of the argument. Since it is not always possible and seldom is profitable to draw a sharp line between wilful and unconscious misinterpretation, it is best to put here only those passages in which Aristotle suppresses important parts of a doctrine for the sake of his immediate purpose while reversing the process in other passages. Such is his treatment of the *Sphere* of Empedocles and the period of the cycle in

which an organized world appears (pages 195 and 196, note 211 *supra*); the conflicting statements about Presocratic ideas of motion exhibit the same tendency (page 171, note 119 *supra*).

2) The accommodation and reinterpretation of theories and axioms the letter of which is not misrepresented cannot with any greater certainty be defined as wilful or unconscious, inasmuch as it is a common human trait to become quickly convinced of the objective truth of one's own interpretations. Aristotle, moreover, had good precedents for this kind of argument in the writings of Plato as well as in the widespread Greek occupation of "interpreting" the poets, particularly Homer. His interpretation of the axiom, "like to like," whereby it becomes the equivalent of his own theory of the actualization of the potential (page 287, note 252 *supra*) is an example, harmless enough in itself but, as supporting his notion that qualitative alteration was recognized by the Presocratics, a source of perversion in the reconstruction and interpretation of early thought. This kind of argument varies from the most perfunctory and incidental byplay to the serious cause of thorough misapprehension.

3) The unadorned misunderstanding of earlier texts and theories has itself varying importance and various reasons. It may result in mistakes of detail or in the misapprehension of the very fundamentals of a theory as it does in Aristotle's interpretation of the cosmogony of Empedocles (pages 188 ff. *supra*). It may, in turn, be due to misreading or failure of memory, or to misinterpretation under the influence of one of the other sources of error (as when his misinterpretation of Presocratic "contraries" causes him to interpret into these systems his own mechanism of alteration) or even to his acceptance of the interpretations of other thinkers. In this last category can immediately be placed those cases in which some chance remark of Plato was taken up and applied as a canon of interpretation, the derivation of the Heraclitean philosophy from Homer, for example, and of the Eleatic system from Xenophanes. Recognition of this last source of error presents



the possibility that Aristotle may have accepted testimony no more plausible from other writers whose books are now lost.

4) One of the most fruitful sources of misinterpretation is the translation into current terminology of earlier theories or, what is much the same process, drawing from the words of an earlier statement the implications which those words came to bear after, often long after, the particular statement in which they stand was made. As this is the most frequent and most fatal of mistakes it is also the most venial, for its avoidance is not altogether possible without a careful study of the history of words and ideas. To Aristotle "contraries" meant contrary, incorporeal qualities; it never occurred to him that for the Presocratics it may have had no such implication. Consequently, he criticizes the "separation" which Anaxagoras assigns to the agency of *νοῦς*, for qualities, he says, cannot exist separately, and applauds again the statement that things are never completely separated, because he supposes this must mean that the quality must inhere in a substrate. If the words of Anaxagoras do not expressly say so, then Aristotle supposes Anaxagoras did not understand his own words. Similarly the word "element" (*στοιχείον*) has come to have a meaning for Aristotle that precludes its application to air, earth, fire, and water; Plato had shown that these were not even "syllables," let alone "letters," and Aristotle can never really believe that Empedocles could have thought that they do not change into one another. In direct defiance of the words of Empedocles, then, he tries to find an alteration of the unalterable "roots." Obviously cognate with this tendency is the inability to understand the attitude of mind, the point of view of earlier thinkers. Aristotle always assumes that the problems which he faces are the same as those which presented themselves to the earliest Presocratics. Since in his day rest was taken for granted while the possibility of motion had to be explained, he cannot imagine that at one time it may have been motion that was taken for granted. The result is that he cannot square the words he has before him with what he supposes must have been the meaning of those words and there is constant con-

fusion in his reports of them (pages 171, note 119; 173, note 128; 193 ff. *supra*).

5) Similar in its effect is the supposition that current ideas must have been present in earlier times even when the words of writers of those times give no indication of them. Such is Aristotle's conviction not that his own theories about the nature of genesis and alteration must have previously existed but that all the Presocratics must have started with genesis and alteration as distinct notions which they then sought in some fashion to reconcile (pages 107, 109 *supra*). In like manner he assumes that the distinction between natural and unnatural motion, the concept of natural place, must have been known to the Ionians (cf. page 30 *supra*); and he fails to consider the possibility that in early reflections concerning numbers the difference between the mathematical concept and the numerable object may not yet have been discerned (cf. page 43 *supra*). Even where it is certain, however, that this attitude has perverted his interpretation, it is not always easy to correct his report with assurance, for, while it is possible that the original doctrine may have contained a fundamental confusion or inconsistencies due to a deficient comprehension of the problems involved, the exact extent and nature of that deficiency and confusion can seldom be accurately determined.

6) The tendency to develop the "necessary antecedents" or "necessary consequences" of an early statement so as to reconstruct the original scope of the doctrine discussed and its intended meaning is one of Aristotle's favorite methods. Since the "necessity" of these connections is always derived from the axioms of his own thought, it is inevitable that he should be able to find in Presocratic writings anticipations and approximations of details in his own system. By this method Anaxagoras is shown to have understood that the "natural" is prior to the "unnatural" and that a precosmical motion would involve a contradiction of this truth (page 194 *supra*); the various "elements" of the Ionians are proved to have been meant as equivalents of Aristotle's own prime matter, since they are presumed to have employed the mechanism of alteration which



itself implies a substrate (cf. page 57 *supra*); and "Love" and "Strife" in the system of Empedocles must have been severally the causes of natural and unnatural motion since these two types of motion could not have been conceived as results of a single cause (page 188 *supra*). The invalidity of such attributions when the whole argument is given is transparent; but where only the results of these reconstructions are stated they have frequently been accepted as genuine evidence, as in the case of the *ἄπειρον* of Anaximander or the "contrary qualities" of Anaxagoras. Such reconstructions are still the favorite tool of historians of Greek philosophy. So, for example, Erich Frank (*op. cit.*, pp. 174 ff.) attributes to Archytas a thoroughgoing "dynamic" theory of existence on the basis of evidence that Archytas defined audible tones as *πληγαί* which are the result of "motions." "Zu dieser dynamischen Weltauffassung," Frank says, "musste Archytas kommen so wie er die Konsequenzen seiner Entdeckung von der Bewegung als dem Wesen des Tones bis zu Ende dachte." Unfortunately the evidence that Archytas did think out the consequences of his discovery is very fragile; and without conclusive evidence for this point the reconstruction remains only a clever guess.

7) Finally, Aristotle's inadequate conception of the historical relationship of the various early thinkers to one another blinds him to the significance of their theories; frequently it must have made their arguments utterly unintelligible, as when his misunderstanding of the purpose of Zeno's arguments caused him to attribute to Zeno himself the premises of the paradoxes and consequently to suppose that Zeno thought his arguments were absolute proof of the impossibility of motion. It is significant that the statement of Plato in his *Parmenides* did not warn Aristotle against this interpretation. Aristotle's apparently sincere belief, however, that each of his predecessors was aiming at the goal represented by his own system and did in fact give a partial expression of that system dissolves all objective relationships among the Presocratics themselves; and on this supposition a history of the development of pre-Aristotelian philosophy is absurd. If everyone was trying to express the same theory, the theory of Aristotle, the only rule

by which all can be judged, compared, and distinguished is the extent to which they succeeded in approximating this norm; and Aristotle is justified in grouping and regrouping them to emphasize now one phase of his theory and again another. Hence Empedocles and the Atomists may be treated as material monists in one connection and in another distinguished from the Ionians as having had an inkling of formal cause. The theory of Anaxagoras may be praised as "modern" when *νοῦς* is interpreted as final cause and yet held to be inferior to that of Empedocles when Aristotle is arguing that a finite number of principles is preferable to an infinite number. The Pythagoreans are treated at length as exponents of formal cause and again ranked with the Ionians since they made number the material of things or dismissed as primitive fabulists when the problem of soul is being discussed. Anaximander is at one time just another Ionian monist, yet elsewhere he is linked with Anaxagoras and Empedocles. And Thales, Anaximander, Anaximenes, Heraclitus are treated as though their differences were exhausted by the name of the "principle" they chose to espouse, although at one time Aristotle undertakes to show that Heraclitus is essentially an atomist. The historical account in *Metaphysics A* is no different from the other passages in which earlier doctrines have been reinterpreted for a special purpose; it has been well described as "a hymn of triumph in honor of the four types of causality." Here, too, when the purpose is understood, it is impossible to criticize Aristotle for misrepresentation or lack of "the historical sense" but it is likewise impossible to use his groupings and representations of the affinity and relationship of various doctrines as historical evidence.

This analysis of the sources of error in Aristotle's reports is not meant to present classifications which exclude one another. Most frequently several at once play a part in the misinterpretation of the doctrines cited and usually all are subordinate to Aristotle's purpose of employing conflicting opinions as the material from which to draw the solution of the problems confronting him. An unambiguous example of this interplay



of the several causes of misinterpretation outlined above, all employed for the dialectical purpose of drawing from earlier conflicting theories his own doctrine which then appears to be a synthesis of the fragmentary truths previously expressed by the contradictory doctrines of his predecessors, is furnished by the development of the theory of interaction (pages 91-94 *supra*). Aristotle's own explanation of change represents it as the actualization in the substrate of the quality potentially present; this quality is the contrary of a quality actually present, these two qualities, as contraries, implying each other. Consequently, interaction from the point of view of actuality is the assimilation of dissimilars but from the point of view of potency the assimilation of similars; and Aristotle introduces these two sides of the theory as separate possibilities before combining them by means of his doctrine of potency-actuality into a single explanation.

We have seen that elsewhere Aristotle himself represents the principle of ὁμοίον ὁμοίῳ as common to all the Presocratics (cf. pages 91, note 387, and 92, note 389); but here he needs some philosophers who can be said to have maintained the opposite thesis. For his statement that most thinkers had held to the interaction of dissimilars he finds support in two ways; he could reinterpret as a physical doctrine the principle of psychological contrast which seems to have been stated by most Presocratics, and by understanding any mention there might be of "contraries" in his own sense of contrary qualities he could deduce as a necessary consequence of such remarks that their authors considered the contrariety as such to be the cause of interaction. By this means he is able to introduce partisans of the notion of interaction between dissimilars and at the same time find historical precedent for his notion of the rôle of contrariety in physical processes; but since contraries in some sense occurred in almost all Presocratic writings he could save for the theory of interaction between similars only the Atomists. He then deduces the "necessary antecedents" of the two attitudes and asserts that the notion of interaction between dissimilars arose because of exclusive attention to the contrary terms of physical process (i. e. change

from contrary to contrary), while the opposite view was the natural result of considering only the substrate of change, a statement which implicitly contradicts his constantly repeated assertion that the Presocratics in general were concerned only with material causes but which enables him to introduce his own synthesis by way of the indissoluble connection of qualities and substrate. This résumé shows not only the complication of many of the sources of error outlined above but clearly demonstrates the methodological purpose of the introduction of previous theories and the general motive for Aristotle's remoulding of the opinions held by his predecessors.

It follows from these observations that the general conclusions to be drawn concerning Aristotle's use of earlier opinions must be scanty, for, if his manipulation of those opinions is determined by the needs of the constructive argument in each case, the evaluation of his reports must be specific and based upon analysis of each passage as it occurs in its proper context. For this reason the detailed conclusions have been given in the preceding chapters along with the analyses from which they proceed. There are, however, a few common errors which recur in all or many of Aristotle's discussions of the Presocratics and which, because of the influence they have had upon subsequent interpretations of Presocratic thought, must be mentioned and analyzed here at the end.

The first of these is Aristotle's conception of the fundamental problem with which all the Presocratics were concerned. In general this is represented as the investigation of the material constituent of all existing things. The Presocratics were concerned almost exclusively with the material element of the universe; for them φύσις meant this and nothing more, and the primary differences of their theories turned upon the nature of this material, whether it was to be considered as unique or multiple, whether it was fire, air, water, or many things analogous to these (cf. page 242 *supra*). Now, apart from the fact that our fragments of Presocratic writings show an interest in physical processes of all kinds at least as intense as the interest in the primary constituents of natural objects and suggest that the "elements" each philosopher posited were determined by



the nature of these processes as he understood it rather than contrariwise, the historicity of this interpretation is called in question by two further facts. Aristotle himself indicates that most Presocratic theorizing was concerned with the nature of specific processes and the explanation of particular phenomena, astronomical, biological, geological, and psychological, and expressly says, even while asserting the above view, that the Presocratics were exercised by reflection on the process of the generation of the universe (cf. page 250, note 135). In the second place, the reason why he should have wanted to restrict the concern of the Presocratics to the nature of the material constituent of the universe is patent. The essential division of nature in his system is that of matter and form; in spite of previous inklings, the importance of the latter element was first recognized and developed by Plato whose chief error was his mistaken conception of the material substrate as non-Being and his consequent misunderstanding of the relationship of form to matter (cf. *Physics* 191 B 35-192 A 34). As Plato, then, represents for him the exaggerated partisanship of formal cause, the Presocratics are made the representatives of the antithesis, so that by playing one against the other he may produce a synthesis of form and matter which is his own system. Consequently in his "history" of previous philosophy the Presocratics all offer only varying theories of the nature of the substrate, and Aristotle never wearies of insisting that for them the whole interest lay in this primal matter. This explains his constantly repeated attempts to reduce Empedocles, Anaxagoras, and the Atomists to material monists not essentially different from the Ionians and to identify the material of all of them with his own matter which is pure potentiality. Where there are elements that cannot easily be reconciled with this interpretation he considers them to be vague premonitions of the other types of causality but tries to show that they are really inconsistent with the chief tendencies of the theories in which they appear. The fact that at times when the purpose of his argument is different he seeks to find in these systems other implications, as when the *Sphere* of Empedocles which is usually identified with prime matter is interpreted as final cause

or when the Pythagorean numbers become formal cause, should only warn us against accepting the more frequent interpretation as correct; and, if it is not correct, any interpretation of Presocratic philosophy which proceeds from this Aristotelian attitude toward it is bound to mistake its purpose both generally and in detail.

The constant interpretation of this material as the substrate of all the individual objects in the physical world caused Aristotle tacitly to assume at all times that the Presocratics had posited the problem of physical change in the same form as that in which it appeared to him, namely the identity of all matter and the simultaneous differentiation of its various manifestations. But to Aristotle this problem was that of subject and predicate, substrate and quality, and the cornerstone of his system is the inseparability of qualities which are at the same time other than the substrate, matter. It is apparent that he opposed this doctrine to that of Plato in which he perceived that qualities, being hypostatized, were no longer essentially predicates; but at the same time he took it for granted that all the physical philosophers also employed in their systems qualities essentially other than the material in which they inhere, and he specifically charges Anaxagoras with the error of supposing that qualities are separable, implying that the duty assigned to *νοῦς* was the sundering of these qualities from the original precosmical matter which contained them (cf. page 52 *supra*). Similarly every mention of the characteristic marks of a natural body to which he refers in Presocratic theory, the hot, the moist, etc., he interprets as indicating a qualitative abstraction, with the result that from his description one would be led to suppose that the earliest Ionians had distinguished the qualities from matter and had devised explanations of change in which these two notions were employed as different elements. If that were so, the concept of quality would display no development in the history of Greek philosophy and the problem of "the One and the Many," of identity and difference, would not play the part that it does in our Presocratic texts, a rôle that Plato frequently mentions (cf. *Parmenides* 128 E ff., *Philebus* 14 D ff.). The theory of Ideas itself shows



how difficult even at the end was the separation of quality from substrate, for even when Plato had torn the qualities away from their foundation in matter he had to give them a substantiality of their own lest they fall short of existence altogether. Such arguments from interpretation are, however, in this case unnecessary, for the *Theaetetus* (182 A-B) tells us unambiguously that both the notion and the name of abstract quality were at the time of its composition innovations. We may, therefore, conclude that any interpretation of a Presocratic in which the notion of abstract quality is employed is thereby vitiated, for what we call a quality was for all Presocratics a characteristic which could not be considered separately from that of which it was characteristic. The attitude of the medical writers to disease was analogous; for them disease, being a condition of the whole organism, was identical with "diseased man" so that an abstracted disease could as such be no object of investigation (cf. H. Diller, *Hermes*, LXVII [1932], p. 21). This proposition has the important corollary that one characteristic does not by its existence preclude the simultaneous attachment of other characteristics, for a given bit of matter may be at once hot, dry, bright, sweet, etc. For Aristotle, however, a given quality could be just itself and nothing more, since its existence must be exhausted by the nature which makes it the quality that it is. The imposition of this notion upon theories that knew nothing of abstract qualities must result in utter confusion, for that material which by a Presocratic is called "hot" because its hotness at the time is its significant characteristic will be translated into a quality that is exclusively "hotness" and all the other characteristics as well as its materiality will automatically disappear.

The medium whereby Aristotle identifies with his own qualities the characteristics mentioned by the various Presocratics is the notion of contrariety. The fundamental qualities in his system are hot, cold, moist, dry; these form two sets of contrary terms. These qualities inhere in the substrate, matter, the existence of which is just the potentiality of receiving these qualifications, and the actuality of one term of the two pairs implies the privation (potential presence) of its contrary. In

this way the four primary bodies are formed, for they are the actualization in matter of hot-dry, hot-moist, cold-moist, cold-dry. Now in almost all the Presocratic systems, especially in the passages on cosmogony, can be found the terms hot, cold, dry, moist; and these Aristotle at once identifies with his own contrary qualities. That they were not qualities in his sense has been established; but they were "contraries" presumably in the sense that what was "cold" could not at the same time be "hot." Aristotle, however, assumes that they were always considered to be the fundamental and primary "contraries" in all physical processes and by this means he assimilates Presocratic theories of matter to his own. There is no difficulty in understanding how the early philosophers might have divided all objects into cold and hot, dry and moist, since these are the most obvious distinctions of physical things. Moreover, since everything appears to be either hot or cold, dry or moist, in cosmogonical systems which employ a sifting or separating process to organize the world, this division, being the most obvious, would also be the first. In that case, however, it is hot and cold matter which is divided apart and to say that the hot and the cold were separated implies that *all things* were distinguished into two general classes. Besides, such a process implies no change of characteristics nor any process by which the hot and the cold are produced from something which previously was neither hot nor cold. Yet Aristotle tries to prove that the cosmogony of all the Presocratics was based upon a single material substrate in which the contrary qualities inhered and that the actualization of these qualities from the substrate constituted for them the organization of the cosmos (cf. pages 53 ff. *supra*). He once, however (*Metaphysics* 1075 B 11-14), complains that those who posit the contraries do not make use of them unless one sets their systems in order; a clearer confession of "recasting" the evidence and "interpreting" the terms to suit his own use one could not ask. The original texts, moreover, show that these two sets of contraries were not the only distinctions brought to light by the cosmogonical motion. Anaxagoras, for example (*fragment* 12), speaks of the separation of dense from rare, hot from



cold, bright from dark, and dry from moist as simultaneous, and in this statement there is no reason to believe that the same bit of material may not be bright, hot, and dry. At any rate in *fragment* 15 there is separation of the dense, moist, cold, and dark from the rare, the hot, and the dry; the bright is not mentioned, which seems to imply that the material classified as rare, hot, and dry is also bright and certainly shows that the characteristics mentioned, while they may have seemed the most prominent, were not considered to be exhaustive. Empedocles also (*fragment* 21) assigns several of the "contrary" characteristics to a single element. It appears, then, that in the cosmogonical process as conceived by many, at least, of the Presocratics the separation was not of qualities as such nor of particles of matter that were characterized by only a single quality; such an interpretation resulted from Aristotle's conception of the words designating the characteristics and his desire to find his own distinction of substrate and quality in the Presocratic systems. He then intimated that the pairs hot-cold, moist-dry which are primary and exhaustive in his own scheme had the same significance in the earlier theories. That this last interpretation was a conscious accommodation is indicated by the fact that the elements "fire" and "night" in the second part of Parmenides' poem are changed by Aristotle to "fire" and "earth" and then identified with the qualitative contraries, hot-cold (cf. page 48, note 192 *supra*).

The relationship of qualities to substrate and the implications of the contrariety of the qualities are the foundation of Aristotle's mechanism of alteration. We have followed his attempt to find qualitative alteration in the Presocratic theories by attributing to all of them with the exception of Atomism the doctrine of the interaction of dissimilars (pages 91 ff. *supra*); and since at the same time we saw that even Aristotle elsewhere ascribed to these systems the principle of *ὁμοίον ὁμοίῳ* which is also supported by the original fragments, this is in itself rather an argument against attributing alteration to any Presocratic theory. Since Aristotle's interest in contrary qualities was due to the fact that for him such contraries were by definition the terms of the process of change and by their

very nature insured the existence and continuance of alteration, he assumed that the mention in any earlier system of contraries—and especially the contrariety hot-cold—was tantamount to the inclusion in that system of qualitative alteration. Hence his determined effort to discover that the principles of all his predecessors had been contraries, an effort which leads him to interpret the "Love" and "Strife" of Empedocles as qualitative states of the world at two different moments and so as the contrary terms of a qualitative change and to give the same meaning to the even and odd of the Pythagoreans (pages 49-50 *supra*). Those thinkers to whom he has already assigned a single element such as water, air, or fire, however, must be shown to have assumed contraries in some other way; and, since qualitative contraries form for Aristotle a relationship of state to privation or preponderance to deficiency, he finds such a contrariety for the Ionians in the mechanism of condensation and rarefaction which he then assigns to all whom he considers to have been monists and interprets as a process of alteration which actualizes the contrary qualities already potentially present in the undifferentiated substrate (pages 50-51, 53-57). The translation of this quantitative change into a qualitative alteration is facilitated by his identification of "the rare" with the quality "hotness," of "the dense" with "coldness." As soon as we have established the fact that abstract qualities are anachronistic for these systems Aristotle's interpretation of the process is unacceptable. Furthermore, his own evidence shows that, since the cornerstone of all these theories was the assimilation of similars, they could have assumed no qualitative change of any kind. And, finally, the extension of the mechanism of rarefaction-condensation to all the monists is itself questionable, for it is obvious that in the case of Thales Aristotle himself had no evidence, in this very context he sets the system of Anaximander in another classification (page 50 *supra*), Heraclitus causes him extreme embarrassment which Theophrastus expressed more ingenuously (pages 14-15 *supra*), and suspicion is cast upon the statement not only by the patent purpose of the generalization here but also by Aristotle's attempt to attribute elsewhere



the same mechanism to Empedocles and Democritus (cf. page 118 *supra*). Anaximander, Anaxagoras, and Empedocles he groups together and says that they derived the contraries by separation from the One in which they were previously present (pages 50 ff. *supra*). Confining our attention for the moment to Empedocles and bearing in mind that to Aristotle these contraries mean the terms of qualitative change while the One plays the part of material substrate, the violent misinterpretation can be proved. We have enough of Empedocles' own words to show that there is no qualitative change in his system, that the four roots are unchangeable in any way, and that the One is simply a mechanical mixture of these roots having existence only as the sum of its parts. It is of some historical worth, however, that Aristotle thought these three philosophers belonged together, since the structure of his argument would not have been injured by placing Anaximander or Anaxagoras with the "material monists." Now Empedocles and Anaxagoras both used a mechanical separation as their cosmogonical mechanism, so that it seems reasonable to conclude that Aristotle is correct in assigning this method to Anaximander also. Since we know that Empedocles did not produce a qualitative change by this means, however, and on this point at least the fragments of Anaxagoras are equally clear, we must conclude that, so far as the present passage reaches, the indications are that in this matter the system of Anaximander was similar to that of the two later philosophers. Aristotle's attribution of qualitative alteration implies, furthermore, the notion of undifferentiated matter, a substrate in which inhere potential qualities not yet realized. In the case of those who posited a definite material as the original principle of the cosmos he suggests that the attempt to attain this conception was not successful; but his interpretation of the *Sphere* of Empedocles and the precosmical mixture of Anaxagoras represents these two states as answering exactly this description (cf. pages 236-7, 141 f., 110). At times he goes so far as to identify not only these but also the material principles of Anaximander and the Atomists with the prime matter which is pure potency (*Metaphysics* 1069 B 20-24). This is to attribute to these thinkers

his own concept of qualitative change along with all its "necessary antecedents," qualities distinct from the substrate, qualities which imply each other as contraries which stand in the relationship of state and privation. But if the only analogue to such a process that can be found among the Presocratics is rarefaction-condensation, if this is quotable only for Anaximenes and even so is a quantitative mechanical change, what basis is there for supposing that the "necessary antecedents" of the process must have been present in earlier thought? Quality as distinguished from matter is not earlier than Socrates, surely; and how can undifferentiated matter be earlier? The original words of Empedocles and Anaxagoras show that these men had no such conception; and, although Democritus allowed only solidity, shape, size, position, and motion to the atoms, Atomism which simply denied the reality of other characteristics was still as far from any notion of undifferentiated substrate as were the other Presocratic theories. The notion of undifferentiated material wherever it is attributed to a Presocratic seems, then, to depend upon these reconstructions and interpretations of Aristotle. In the case of Anaximander, however, many modern historians have maintained that this interpretation is correct, that his *ἀνείρον* was really a qualitatively indeterminate material from which the qualitatively distinct physical bodies are developed (cf. Ueberweg-Praechter, *Geschichte der Philosophie*, I, p. 49; Zeller-Nestle, *op. cit.*, I, pp. 275-291; Burnet, *E. G. P.*,<sup>8</sup> p. 58; A. Rey, *La Jeunesse de la Science Grecque*, pp. 57-59); yet none, so far as I know, definitely admits what is required by this supposition, that such a notion implies the conceptions of separable quality and qualitative alteration. The problem of Aristotle's influence upon the interpretation of Anaximander in particular, however, must for the moment be postponed, for connected with the tendency to see in earlier theories his own notions of substrate, contrary qualities, and alteration is his interpretation of the problem of identity in these same systems.

Heidel has conclusively proved that Aristotle was able to attribute qualitative alteration to the earliest physical philosophers only because he assumed without question that the no-



tion of "element" implied for them the same conception of identity as he himself used in defining it (cf. *Archiv für Geschichte der Philosophie*, XIX [1906], p. 341 and notes 18 and 20 *ibid.*) and also that, in the final analysis, such an interpretation depends upon the assumption that for these thinkers qualities were abstracted from the matter of which they could be predicated (*ibid.*, p. 343). In the passage of the *De Generatione*, where the inevitable consequences of the identity and multiplicity of the physical principles are developed (314 A 6 ff.), Aristotle's purpose is to discover among his predecessors a group which reduces all change to alteration and another which distinguishes between alteration and genesis. On the basis of his own conception of unity as identity which excludes difference he then cites the Ionians as representing the former view and Empedocles, Anaxagoras, and the Atomists as holding the latter theory, although he has to admit that Anaxagoras explicitly denied the distinction. Such an interpretation forces him to set the history of philosophy on its head by attributing to the earliest thinkers a strictly logical conception of identity which was later abandoned for the theory that things are at the same time one and many (cf. *Physics* 187 A 12 ff.). If then one were restricted to the remarks of Aristotle, it would never appear that the development of philosophical thought before his time was largely determined by the question of the relationship of the One and the Many which manifested itself in a long struggle to clarify the problem of identity and difference (cf. A. Diès, *Revue d'Histoire de la Philosophie*, I [1927], p. 15). His assumption that the Ionians were aware of the logical implications of identity, for one thing, makes the position of the Eleatics inexplicable; and the effect of this historical misconception comes vividly to light in his interpretation of Parmenides' identity of Being as an identity of contraries (cf. pages 63-67 *supra*). To follow the steps toward the clarification of this problem and its solution in Plato's theory of predication and Aristotle's elaboration is to trace out the chief line of development in Greek philosophy. Here it is necessary only to show that the abstraction of qualities implied in the notion of unity which Aristotle assumes for the

Ionians was the goal of the development and was not reached by any Presocratic. This is sufficiently proved by the evidence already adduced and by the following indications. Even Protagoras in order to explain the possibility of psychological relativism supposed that the various and conflicting characteristics perceived by men all exist objectively as material parts of the perceived object, the varying physical constitution of the sensory subject determining which of the ingredients may be perceived (cf. Sextus, *Pyrrhon. Hypotyp.*, I, 217 ff.). Here there is no notion of a potency in the object by which it may become differently qualified in different circumstances; both contrary qualities already exist in it as ingredients, a notion far different from that relativism developed by Plato in the *Theaetetus* (156 C ff.). Democritus, also, when he restricted the characteristics of his atoms to certain quantitative determinations, could only deny absolutely the qualification of matter and explain the apparent characteristics as essentially the quantitative determinations of the atoms in motion through the interstices of complexes of atoms (cf. *fragments* 55 B 9, 55 A 49; Theophrastus, *De Sensibus*, 63 ff. where the notion of ἀλλοίωσις, however, is read into the doctrine by Theophrastus, cf. Heidegger, *op. cit.*, pp. 374-377). This represents a distinct stage in the development of the problem, but even here there is no thought of attributing real existence to qualities apart from matter; the presumption of the Atomistic doctrine is rather that either "the hot" must mean "a hot thing" or else there can be no such thing as heat. The novelty was simply the conviction that the second alternative could be assumed without rendering an explanation of phenomena impossible. The possibility that the predicate characteristics of matter may change is not yet envisaged, because no distinction has yet been made between the predicate and that which it characterizes. The persistent difficulties caused by the universal assumption that qualities are substantial Atomism sought to solve by the radical method of denying existence to qualities completely and reducing the characteristics of matter to a few quantitative terms. In order to reestablish the qualities Plato had to find for them an immaterial substantiality and discover that the relationship of subject

to predicate was one of significant meaning rather than of existential identity. That the quality and thing qualified were identified in earlier thought is indicated by the reference in the fourth book of the *Meteorology* to the debates about the question of whether certain objects are "cold" or "hot" (cf. page 267 *supra*). There the criticism is made—quite correctly, from the point of view of Aristotle—that such debates are due to the failure to distinguish between the material substrate and the informing quality, a remark which bears witness against the more usual assumption that the Presocratics separated the qualities from matter. An interesting commentary upon the meaning of such terms as θερμόν, ψυχρόν, etc., at the end of the Presocratic period is furnished by the Hippocratic essay *περὶ ἀρχαίης ἱητρικῆς*; the author attacks such medical theories as try to explain diseases by the influence of the hot, the cold, or some such single principle and to cure diseases by prescribing a food which is supposed to fall into one or the other category. It is assumed throughout that the hot or the cold, etc., mean hot or cold objects (e. g. § 14, p. 602, Littré: τῶν βρωμάτων ὅσα ἡμῖν ἀνεπιτήδεια ἐστὶ . . . τούτων ἕκαστον ἢ πικρόν τι καὶ ἄκρητόν ἐστιν ἢ ἀλμυρόν ἢ ὀξύ ἢ ἄλλο τι κτλ.) and that an attempt was made to characterize each object as one or the other of these. The author then proceeds to show that it is impossible to construct a method of therapy upon this foundation because there is obviously nothing in the world that is exclusively hot or cold or dry or moist (§ 15, p. 604, Littré: οὐ γὰρ ἐστὶν αὐτέοισιν . . . ἐξευρημένον αὐτό τι ἐφ' ἑωυτοῦ θερμόν ἢ ψυχρόν ἢ ξηρόν ἢ ὑγρόν μηδενὶ ἄλλῳ εἶδει κοινωνέον ἀλλ' οἶμαι ἔγωγε ταῦτα πόματα καὶ βρώματα αὐτέοισιν ὑπάρχειν οἷσι πάντες χρεόμεθα). It is, therefore, necessary in interpreting the Presocratics to free ourselves from the Aristotelian notions that such terms as hot and cold refer to immaterial qualities and that what is characterized as "the hot" must not at the same time have other characteristics. Only so can a proper beginning be made in understanding the several Presocratic theories and the gradual development resulting from the criticism and correction of one philosopher by another.

By assuming his own conception of identity for all the Presocratics Aristotle is bound to identify their elementary prin-

ciples with his own elementary bodies, interpreting them as bodies of which the substance persists while the qualitative characteristics change (cf. *Metaphysics* 983 B 8 ff.). That this definition will not fit the four roots of Empedocles, the characteristics of which never alter, is certain, although from the definition itself Aristotle tries to argue that the roots must have been subject to alteration (cf. page 110 *supra*); at the same time its inappropriateness when applied to the Ionians is exemplified by Aristotle's argument that their assumption of a persistent, identical substrate proves that they reduced all change to alteration (cf. page 109 *supra*). In the case of the "air" of Anaximenes we are not justified in assuming with Aristotle a persistence in his sense which implies logical identity and physical homogeneity. Quite naturally, since Aristotle assumes identity in this sense, he also takes it for granted that for the Presocratics any part of such a body as air or fire is in essence identical with the whole mass, an assumption which has introduced further confusion into the interpretation of various Presocratic doctrines. The mistake is patent in his critique of Atomism, for he considers each particular "soul-atom" identical with soul and each "fire-atom" identical with fire and on this basis identifies fire and soul (cf. pages 262, note 181; 289). Aristotle himself assumes that fire, for example, cannot consist of elementary parts which are not themselves fire and so that the Atomists too must have considered each spherical atom to be identical with fire; then he argues that, since a sphere is not divisible into spheres, there is a minimal quantity of fire or fire must consist of parts which are not themselves fire (cf. pages 8 ff. *supra*). The Atomists, however, not only claimed that the spherical atom was indivisible but asserted that fire is *made up of* spherical atoms, which does not imply that spherical atoms themselves are fire any more than Plato's construction of fire molecules from certain triangles implies that these triangles are fire. Aristotle attacks this Platonic theory on the same grounds and assumes that for Plato as well as Democritus the elementary constituent of fire must have been identical with phenomenal fire. Since it is clear that this misconception is due to his doctrine of essen-



tial identity, a doctrine which he assumes for all his predecessors, it is probable that the same misapprehension has prejudiced his interpretation in other cases; and we have in fact found that he identified the "roots" of Empedocles with the great masses of air, earth, fire, and water and that in the arguments of Anaxagoras he confused atmospheric air and the mass of earth with the seeds of air and earth (cf. pages 119-120 *supra*). The influence of this misinterpretation has lived on to modern times; as it gave Aristotle the opportunity to castigate the Presocratics for self-contradictions of which they were not guilty, it has put upon modern historians the apparent necessity of constructing complicated systems by means of which they may "explain" for these philosophers conflicting elements in their theories that did not exist until Aristotle introduced them.

As in the case of qualitative change, so too in that of local change Aristotle's habit of citing and criticizing previous doctrines only in connection with the exposition and defense of his own theories has obscured a critical phase of the historical development. Since for him the phenomenon of motion could be analyzed only by means of the fourfold causation, either he had to suppose that no one had ever discussed motion as such inasmuch as no one had given an account of all four types of causality or else he was bound to discover in the Presocratic systems a recognition of these causes in their relation to motion. This is the reason for his conflicting statements about the earlier attitudes toward the phenomenon (cf. e. g. pages 171-174 and notes *supra*) and the origin of his various identifications of the motive principles of Empedocles and Anaxagoras (cf. pages 234 ff. *supra*). The abstraction of the efficient cause in his own system, an abstraction which made this type of causality a phase of formal cause (cf. page 245 *supra*), made it impossible for him to recognize the stage from which the development of the problem began. That the crisis in the Greek attitude toward motion like that in the view of change generally depended upon the development of the radical statement of the principle of identity by the Eleatics Aristotle never recognized; consequently he never saw that his problem of

motion was at first no problem at all, since for the Ionians the logical difficulties of change in general had not yet been posed. The Eleatic theory he considers to be entirely unrelated to physics (cf. page 155 *supra*), although in trying to find a place in history for the notion of efficient causality he explains the Eleatic thesis as due to recognition of the necessity for such a cause of motion and concomitant inability to discover such a cause (cf. pages 220-221 *supra*); the result of this interpretation is the identification of the motive principles of Anaxagoras and Empedocles with efficient causality in his own sense and the consequent discovery of innumerable inconsistencies in these systems, for it is clear that in both many movements occur which are not *directly* induced by the motive principle. So Aristotle fails to understand the purpose these principles served in answering the Eleatic objection, for the Eleatics did not directly attack the principle of mechanical causation that was sovereign from Anaximander to Socrates as he might himself have seen had he considered the fact that, according to his own interpretation in one context at least, the Atomists thought their system answered the Eleatic criticisms, yet they introduced no so-called efficient cause. His system of causality, however, so far abstracts motion from material that in such systems as do not he can perceive only material distinctions and can allow no influence to such elements as force and velocity (cf. pages 262, note 181; 289, note 3). In one case, it is true, he finds with rather more justice the efficient cause in the material bodies of all the Presocratics; but that identification is unusual and is induced by the desire to criticize the theory of the *Phaedo*, and even there he proceeds to argue that these material bodies cannot themselves be causes of activity so that the efficient cause must be separate, i. e. form (page 228, note 48 *supra*). The attempt to fit motion, wherever it is mentioned, into his own scheme of causality results not merely in a lack of sympathy for the notion of mechanical cause but in complete oblivion to the possibility of such a conception. The disjunction of fortuitous and purposeful is justified in his own system but it is a useless distinction in analyzing Presocratic theories which recognized neither term of the disjunction, and

it causes Aristotle to misinterpret both "chance" and "necessity" where those words are used by the Presocratics as well as the whole spirit of Presocratic thought (cf. pages 246-250 *supra*).

The settled notion that all the Presocratics were interested exclusively in matter and attempted to refer everything to their material principles, a notion which, as has been seen, takes its rise from the attempt to analyze all previous philosophy as a foreshadowing of the doctrine of fourfold causality, obscures the relationship of religious ideas to earlier philosophical thought. Aristotle, consequently, disregards the possibility of a difference of attitude among the various Presocratics in regard to the soul and insists that all alike identified the soul with their material principles, an interpretation the application of which to the system of Empedocles was shown to cause confusion and misunderstanding (cf. pages 293 ff. *supra*). Even in the case of the Ionians the principle apparently will not fit Anaximander (cf. page 300, note 36 *supra*); and in order to prove its applicability to Parmenides and thinkers later than him Aristotle has to resort to the contention that they all identified thought and sensation, a statement which is in itself suspicious (cf. pages 313, note 87; 292, note 10 *supra*) and for Empedocles certainly and the Pythagoreans probably irrelevant besides. This thesis, incidentally, leads him on to attribute a relativism to many philosophers who clearly sought to distinguish reality from appearance and who in some cases positively attacked doctrines based upon the relativity of sensations. From Aristotle's account, however, it would appear that all Presocratic notions of the soul agreed in the fundamental principle of reducing the psychical essence to physical elements; but this thesis betrays itself by its own inconsistencies and at the same time disregards the important indications furnished by our other evidence according to which the western schools, at any rate, were strongly influenced by the desire to combine a mechanistic physics with a psychical mysticism (cf. P.-M. Schuhl, *Essai sur la Formation de la Pensée Grecque*, pp. 263 ff.).

These are the errors of interpretation which influenced Aris-

totle's general attitude toward the Presocratics and which continue to have an effect on modern historians. It remains for us only to indicate to what extent their correction would affect certain critical problems in the history of the development of early Greek philosophy.

The Ionians Aristotle represents as material monists who differed from one another only in that each chose a different material as his principle. They all were then supposed to develop the contrary qualities from this substrate and so to forecast the Aristotelian system of an alteration taking place in an identical substrate and occurring between the terms of a qualitative contrariety. This is the view that is still usually represented in histories of philosophy; that it contains implications impossible for any Presocratic we have already seen.

Of the details of Thales' system—if, indeed, he had one—it is impossible to say anything. Aristotle himself admits that his knowledge of Thales is restricted to two or three traditional stories; these he interprets so as to fit Thales into his own interpretation of the Ionians. Specific evidence for or against the details we have none; and the only honest course is to make the history of Greek philosophy proper begin with Anaximander.

Anaximander called his principle τὸ ἄπειρον; we have already seen that the modern interpretation of this as a qualitatively undifferentiated body from which the qualities are developed depends upon a tendency of Aristotle's treatment which can be proved to be mistaken in the case of other Presocratics and that it implies in the case of Anaximander elements which are so anachronistic as to be impossible. Besides, in one context, Aristotle himself associates Anaximander with Anaxagoras and Empedocles, opposes this group to the "monists," and says that Anaximander as well as the other two posits a mixture from which he derives other objects by a process of separation (*Physics* 187 A 20-23). Similarly in the *Metaphysics* (1069 B. 20-25) Anaximander is associated with Anaxagoras, Empedocles, and Democritus as thinkers whose precosmical material can with a slight interpretation be identified with the Aristotelian potential matter. The second of these passages



Burnet rejects as "of no consequence," the first he does not mention; but he accepts the arguments Aristotle gives (*Physics* 204 B 22-29; cf. Burnet, *E. G. P.*,<sup>8</sup> p. 53) for the assumption of an infinite body as a principle prior to the phenomenal bodies as substantially the reasoning of Anaximander, although it is in fact the peculiarly Aristotelian argument of the necessary equilibrium of contrary forces (cf. pages 27-30 *supra*). The nature of Burnet's criterion in judging the value of these various passages must ever remain unknown; the result of it is that found in so many histories that do lip-service to the principle that Aristotle's accounts are unhistorical: one chooses the passage that fits one's theory and rejects the rest. Burnet is really following the doxographical notice that most historians follow which says that Anaximander made his principle τὸ ἄπειρον "in order that becoming might not fail" (cf. pages 19 and 21 *supra*), although Simplicius (*Phys.*, 466, 30) assigns this reasoning not to Anaximander but to "some of the physicists" and one of the Aristotelian passages (*Physics* 208 A 8 ff.) gives it as the presumable reason for positing ἄπειρον σῶμα αἰσθητόν, the last word of which phrase, if it refers to Anaximander, does not support the theory that the ἄπειρον was an undifferentiated, unqualified substance. In this matter, however, we can appeal from the doxographers to the words of Anaximander himself. Aristotle, in the passage just cited, dismisses this argument for an infinitely large material principle by saying that becoming can be eternal anyway if the destruction of one thing is the origin of another. In the one sentence of Anaximander that remains to us (*fragment* 9, Diels) this very principle is stated: "things pay a penalty and recompense to one another for their injustice in the fixed order of time"; and the preceding words, if not Anaximander's own at least a paraphrase of them, explain: "out of those things from which is birth for the things that are into those things is also death as is proper." Here is the cycle which, Aristotle says, once recognized obviates the necessity of infinite material in order that the process may not cease. The unlimited extent of the principle could not have been meant to explain the unlimited continuation of the world process; it might have

been a consequence, however, of the assumption of an unlimited number of worlds (cf. Aëtius II, 1, 8, cf. II, 1, 3; Simplicius, *Phys.*, 1121, 5-9), although it is impossible to say which opinion was prior or even that both did not depend upon some previous assumption. But is the essential nature of this principle also expressed by the name ἄπειρον, and if so what was that nature? It is pretty clear that Anaximander specified its nature by no other term; but, besides the objections already raised to the interpretation which makes the principle "undifferentiated matter" and so ascribes the notions of abstract quality and alteration to Anaximander, there is evidence in the sentence we have already cited to show that it was not a single body at all. ἐξ ὧν ἡ γένεσις ἐστὶ τοῖς οὖσι καὶ τὴν φθορὰν εἰς ταῦτα is translated by Burnet as "into that which . . .," by Diels as "woraus . . . dahin . . .," by Tannery as "c'est de là . . ., c'est en cela . . ."; whether the sentence is a direct quotation or a paraphrase of Theophrastus the plurals, ὧν . . . ταῦτα, are important for they refer to the ἄπειρον and imply that the material principle of existing things is not a single entity but a multitude of some kind. Can the word ἄπειρον itself signify not merely "unlimited in extent" but also "consisting of an unlimited multitude"? Anaxagoras, whose "original mixture" we know consisted of an unlimited number of "seeds," uses ἄπειρον to refer both to size and number; he usually specifies the meanings, however, as in the phrase ἄπειρα πλῆθος καὶ σμικρότητα, but in his first fragment he says of the air and ether that prevailed over all the ingredients of the mixture ἀμφοτέρω ἄπειρα ἔοντα. Here ἄπειρον stands alone, but that even so it refers both to the quantity of particles and to the size of them the next sentence proves: ταῦτα γὰρ μέγιστα . . . καὶ πλήθει καὶ μεγέθει. In *fragment* 2 he calls the circumambient mixture ἄπειρον τὸ πλῆθος. So it is clear that ἄπειρον may mean not only "of infinite extent" but also "of an infinite number of parts." Plato in the *Philebus* also uses the word to signify the sum of an infinite number of parts, "an indefinite multitude," and "an indefinite multitude of different kinds" (*Philebus* 18 A-C, e. g. φωνὴν ἄπειρον κατενόησεν . . . τὰ φωνήεντα . . . οὐχ ἓν ὄντα ἀλλὰ πλείω . . .); but the most striking parallel occurs in the *Politi-*



*cus* (273 D) where God again takes the helm of the world-ship *ἵνα μὴ . . . διαλυθεῖς εἰς τὸν τῆς ἀνομοιότητος ἄπειρον ὄντα πόντον δῦν*. Here ἄπειρον perhaps means that the sea is infinite in extent, but it also means that that sea itself is nothing more than a congeries of elements infinite in number and in dissimilarity. That this is a satisfactory description of τὸ ἄπειρον of Anaximander I think is certain; one may add for what it is worth the doxographical account of Augustine (*De Civ. Dei*, VIII, 2): Non enim ex una re, sicut Thales ex umore, sed ex suis propriis principiis quasque res nasci putavit. Quae rerum principia singularum esse credidit infinita. . . . It now appears that there may have been another reason for calling the principle "infinite"; since in the world about him Anaximander saw an infinity of differences, he may have felt that the same infinite variety must be assumed for the great stock of original material. Abel Rey (*op. cit.*, p. 59, n. 1) thinks that the interpretation of Anaximander's "infinite" as a mixture of particles is merely a confusion with the theory of Anaxagoras; there is no confusion, but rather the critical testing of our sources forces us to admit that the "métamorphose qualitative" that Rey attributes to Anaximander (*op. cit.*, pp. 72-73, p. 90) is merely Aristotle's accommodation and reveals that Anaxagoras sought by a refinement of the old Ionic doctrine to meet the Eleatic objections without falling into the difficulties of Empedocles. Nor is there any more reason to adopt Aristotle's method of making a monist of Anaximander than there is to follow him in his similar treatment of Empedocles and Anaxagoras (cf. pages 110-111, 142, 50 *supra*). The doxographical tradition is under the influence of these tendencies of Aristotle: what are we to say to Theophrastus' statement that by τὴν μῖξιν τῶν ἀπάντων Anaxagoras meant to represent μίαν φύσιν ἀόριστον καὶ κατ' εἶδος καὶ κατὰ μέγεθος and his designation of this "single principle" as ἡ τοῦ ἀπείρου φύσις (Theophrastus, *Phys. Opin.*, fragment 4 [*Doxog. Graeci*, p. 479, 12-15])? Just that Theophrastus took the *ad hoc* interpretations of Aristotle at least as seriously as the original writings of the Presocratics! And yet Theophrastus knew that there was no alteration in the system of Anaximander (*Doxog. Graeci*, p. 476,

13-14); where, then, is the evidence for a "métamorphose qualitative"? There is no room here for "differentiation," since the hot things and the cold exist as such from all eternity. They are taken from the infinite mass to form individual objects and are repaid to it as is proper. That the specific character and form, the inner and outer limits, of these ingredients of "the unlimited" were not further defined was natural at a time when the difficulties of the concept of identity had not yet been recognized; the system, so far as we know it, shows that Anaximander was primarily interested in the process by which the world exhibits its changing phases, a process which he envisaged as a balancing of individual accounts in the fund of a common mixture.

Anaximenes' chief interest was also in this process, and his great contribution was his discovery of a single mechanical contrivance which he thought could explain all the changes that nature manifests (Theophrastus *apud* Simplicius, *Phys.*, 149, 32; Hippolytus, *Refut.*, I, 7); it is the definite unity of this mechanism of rarefaction-condensation, rather than the fact that the great mass of material that surrounds all the world and is infinite in extent has been given the definite name of "air," which lends an aspect of "monism" to his system. To this "air" the doxographers, following Aristotle, give the name ἀρχή and so import into the notion the Aristotelian concept of an identical substrate subsisting throughout the alterations of quality; but through their accounts which are so recast as to make it seem that the underlying air subsists while its qualities change the original meaning still is clear: one body *becomes* another by reason of the process of compression and rarefaction, water changes into earth and earth into water. Air gets the rôle of honor simply because it is the most extensive of all bodies and "the most evenly distributed" (fragment 3 B 2, Diels; cf. the passage of Hippolytus cited above and note there the interpretation of πῦρ γίνεσθαι etc. as πυκνούμενον . . . διάφορον φαίνεσθαι. Cf. Plutarch, *Stromat.*, 3 = *Doxog. Graeci*, pp. 579-580) and also because of the identification of the air in our bodies with the soul, the principle of life (fragment 3 B 2, Diels). The process of change is mechanical; Aristotle's at-



tempt to interpret it as qualitative alteration is impugned both by his own method and by the description of the mechanism. The air is consequently not conceived to be qualitatively indifferent, nor does the definite designation of it as "air" imply here an identity which includes homogeneity, for the other characteristics of the air as of all bodies depend upon the mechanical distribution of its parts (ὅταν μὲν ὁμαλώτατος ᾖ ὁψι αἶθρον κτλ.; cf. Aristotle, *Physics* 260 B 11: πύκνωσις δὲ καὶ μάνωσις σύγκρισις καὶ διάκρισις καθ' ἃς γένεσις καὶ φθορὰ λέγεται τῶν οὐσιῶν). Such a notion involves the logical difficulty of identifying the "parts"; but that the Ionians paid no attention to this problem the criticism of the Eleatics shows. The important advance made by Anaximenes, however, was the introduction of the notion that all things change according to a single quantitative mechanism; this notion leads directly to the conclusion of physical relativism, for, if water is air that has been "rearranged" by compression, air is also water that has been "rearranged" by rarefaction. Only the process remains fixed and this conclusion Heraclitus proceeded to draw with radical thoroughness.

Heraclitus believed that he had discovered a truth which none of the teachers of men nor any of the mass of men had yet recognized although it manifested itself to everyone at every turn (*fragments* 17, 72, 40, 129); what this truth that exhausts all truth is cannot be merely that fire rather than air is the material constituent of things. It has been long since noted that in all Plato's references to Heraclitus the doctrine of elemental fire is never mentioned but the kernel of his teaching is summed up in the phrase πάντα ῥεῖ (cf. Baeumker, *Problem der Materie*, p. 22 and Plato, *Sophist* 242 D-E). The fragments that remain state the thesis that everything is itself and its opposite, all things are both one and many, because all things are in a constant flux (*fragments* 49 a, 50, 51, 62, 91); and it is ignorance of this with which Heraclitus expressly reproaches the "wise men" of the past (*fragments* 56, 57). This flux, however, is not without order; it is rather a harmony which, though hidden, far surpasses that which men grasp with their senses (*fragments* 28, 41, 54, 94). To express

the same thought Heraclitus said that the world is an ever-living fire "kindling according to measure and according to measure being extinguished" (*fragments* 30, 90). It was this type of statement from which Aristotle proceeded to find in Heraclitus just another "material monist" who had substituted fire for the air or water or "infinite" of the previous Ionians; and ever since the argument has raged as to whether this "fire" was a real substrate or a symbol only. But evidently Heraclitus did not distinguish between the sign and the thing signified; fire is both a token for exchange like gold in trade (*fragment* 90) and is involved in change itself (*fragments* 76, 126). The strife that the poets had wished to banish, the encroachment of the individual things upon one another that to Anaximander had seemed an injustice to be expiated by dissolution into the original stock of material Heraclitus lauded as the very essence of existence, as the Justice by reason of which all things are what they are—even fire (*fragments* 53, 80, 84, 88). That he could have called the whole process fire without conscious symbolism on the one hand or the notion of a substrate persisting as identical throughout its qualitative alterations on the other presents no difficulty, for fire itself seems to be the one existing phenomenon which is nothing but change itself. So too the Buddhists use it, for whom there is no Being but only constantly shifting events in Becoming which is itself merely flux, flux of nothing. To cite Aristotle as evidence for the interpretation that the fire of Heraclitus was on the same level as the "air" of Anaximenes (Burnet, *E. G. P.*, p. 145, n. 1; cf. also Rey, *op. cit.*, p. 89) is as useless as to accept his explanation that fire was chosen for the substrate because it was the rarest of materials known. His reason for trying to make it a persistent substrate has been amply discussed; and it is certain that the characteristic of fire which to Heraclitus seemed primary was the impermanence without which it never exists, for this is according to him the prime characteristic of all existence and this alone can be the reason for equating fire and the world. The relationship of this doctrine to the discovery of Anaximenes is clear. The latter had shown that a single mechanical law of quantitative change would explain



the shifting diversity of the world; fire, air, earth could all be reduced to degrees of compression. But the matter which changes he still retained and even clung to one phase of it as somehow more potent than the others. Heraclitus simply followed the new discovery to its logical conclusion, for it too implied that everything was one and many, one thing now and many things before or hereafter. It is then the process which is the real Being, and all the distinctions men see are but fleeting phases of the process; even so, if everything were smoke and all the other senses declared the single identity of all, the nose would still deny it and smell out difference (*fragment 7*). Although nothing can be proved by comparing ancient doctrines with modern philosophical theories, I cannot refrain from setting beside this statement of the "discovery" of Heraclitus the words of Professor Whitehead (*Science and the Modern World*, p. 106). "Thus nature is a structure of evolving processes. The reality is the process. It is nonsense to ask if the colour red is real. The colour red is ingredient in the process of realisation. The realities of nature are . . . the events in nature."

So we find no "material monism" in the Ionic theories all of which Aristotle reduced to this formula. Instead there appears to be a steady and swift development of the problem of change starting with Anaximander's theory of separation and commingling, developing through Anaximenes' notion of a quantitative mechanism reduced to a single simple law and making the nature of all physical bodies relative to the degree to which the mechanism has been applied, and ending in Heraclitus' radical thesis that all distinctions are merely superficial phases of the universal process of change besides which nothing exists, the process itself being a fire whose whole existence is exhausted by constant coming to be and passing away. Throughout these theories continuous motion seems to be taken for granted as one of the essential characteristics of all material things; and there is as yet no notion of an identity that excludes difference.

Heraclitus' bold statement, however, that everything is what it is just *because* it is at the same time other than itself or, to

put it in abstract language, that identity consists in difference since each individual object is constantly changing in different directions, each part of the whole, like the whole world-fire itself, kindling in measure and in measure going out, called forth a protest that checked this whole train of thought. That the poem of Parmenides is directed *solely* against Heraclitus is a contention much too narrow to be maintained; that it directly criticizes Heraclitus among others is certain, and it seems highly probable that Parmenides was impelled to set down his system in writing by the disgust he felt upon seeing the loose logic and haughty words of Heraclitus (cf. Zeller-Nestle, *op. cit.*, I, p. 684, n. 1; E. Loew, *Rheinisches Museum*, LXXIX [1930], pp. 209-11; W. Kranz, *Hermes*, LXIX [1934], pp. 117-18). The recent attempt of Rey to show that Parmenides wrote earlier than Heraclitus fails completely, for it rests upon external chronological evidence which Rey himself rejects in other parts of his work (A. Rey, *op. cit.*, p. 185; the *floruit* given by Apollodorus for Parmenides is accepted here but elsewhere rejected in favor of the testimony of Plato; the date 478 B. C. for Heraclitus' book accepted here is rejected on p. 313). The whole burthen of Parmenides' poem is the opposition of Being and non-Being, the insistence that the identity of what *is* precludes the possibility of any characteristic beside just *being* (cf. A. Diès, *Revue d'Histoire de la Philosophie*, I [1927], pp. 16-17). In short, in answer to Heraclitus Parmenides stated the law of the excluded middle and said that that one law invalidated not only Heraclitus' thesis but all the theories which, disregarding the fact that a thing is what it is, proceeded to talk about change as if not every object of thought and so every existing thing had either to be or not to be (Parmenides, fragment 8, lines 15-16: ἡ δὲ κρίσις περὶ τούτων ἐν τῷ δ' ἔστιν· ἔστιν ἢ οὐκ ἔστιν); here lies the decision, but to put the case is to answer it, for to think of anything is to think of it as being (Parmenides, *ibid.*, lines 16 ff.: κέκριται δ' οὖν, . . .). The essential nature of Being, the inner necessity that a thing is identical with itself, holds it fast in bondage and allows it neither to come to be nor to pass away (Parmenides, *ibid.*, lines 13-15; cf. H. Fränkel, *Parmenidesstudien*, pp. 159-169).



The impossibility of process is established by the logical consequences of identity (Parmenides, *ibid.*, line 21: τὼς γένεσις μὲν ἀπέσβησται καὶ ἄπυστος ὄλεθρος). There are slight hints in several places that Aristotle was aware of the logical basis of Parmenides' doctrine and of its main conclusion that process is impossible on this basis (cf. pages 63, note 258; 70, note 288 *supra*), but the historical connections he did not understand, and his usual treatment of the Eleatics is much different. His tendency even in the above passages is to consider the doctrine of Parmenides as a positive physical theory. So he at one time identifies the Eleatic "One" with the "unified material" of the Ionians and represents the development of the doctrine as due to the recognition that an efficient cause apart from matter is necessary for motion. Since the Eleatics could discover no satisfactory force to play this rôle, however, they insisted that the material must be immobile (pages 220-221 *supra*). Here Parmenides is made out to be a "material monist," identical with Thales, Anaximander, Anaximenes, and Heraclitus except in his contention that the substrate does not move. Elsewhere the doctrine originates in the belief that a void is necessary for motion but that as there is no void matter cannot move (page 95, note 401 *supra*). Finally the Eleatic unity of Being is said to be an identity of contradictory attributes, and Parmenides is made a relativist of the same kind as Heraclitus. The last interpretation is motivated in part by Aristotle's analysis of the later influence of the Eleatic thesis (pages 64-67 *supra*). The attitude of Aristotle toward the Eleatic school is of prime importance, for the criticism contained in Parmenides' poem changed the whole course of Greek philosophy and to overlook that fact is automatically to misunderstand the development of thought both before and after this crisis.

Parmenides himself according to one line of tradition had been powerfully influenced by a member of the sect or school of Pythagoras (Diogenes Laertius, IX, 21), and we have now to consider a few of the questions that arise in connection with Aristotle's treatment of this school. His manner of referring to its members as οἱ Ἰταλικοὶ or οἱ περὶ τὴν Ἰταλίαν or οἱ καλούμενοι

Πυθαγόρειοι as well as by the simple οἱ Πυθαγόρειοι has aroused much speculation, and it has been suspected that by "the so-called Pythagoreans" Aristotle meant to indicate that the doctrines in question were not those of genuine Pythagoreans but had in one way or another been fathered on the old sect. The use of the phrase, however, does not imply this subtlety as the similar phrase οἱ καλούμενοι γεωργοί shows (*Politics* 1290 B 40; cf. Xenophon, *Cyropaedia*, II, 1, 9 and Hippocrates, *περὶ διαίτης ὁξέων*, § 1 [Littré, II, p. 224]); and, since Aristotle refers the same doctrines to οἱ περὶ τὴν Ἰταλίαν, οἱ καλούμενοι Πυθαγόρειοι, and οἱ Πυθαγόρειοι, he obviously meant the same persons by all these appellations (cf. *De Caelo* 293 A 20 with 293 B 1; *Metaphysics* 985 B 23 with 987 A 10, 987 A 13, 986 B 1, and 987 A 31). The longer phrase is infrequently used; but that it indicates a distinction of later from earlier Pythagoreans or the use of a source in which Aristotle had not complete confidence is disproved by a comparison of the above passages. The longest phrase of all, τῶν δ' Ἰταλικῶν τινες καὶ καλουμένων Πυθαγορείων, which in *De Caelo* II, chap. 13 in the form οἱ περὶ τὴν Ἰταλίαν καλούμενοι δὲ Πυθαγόρειοι seemed to Tannery to indicate that Aristotle knew the theory in question there was not truly Pythagorean (*Revue des Études Grecques*, X [1897], pp. 129-133) is used in *Meteorology* 342 B 30 in connection with a theory of comets which in a slightly more complicated form is also ascribed to Hippocrates of Chios and so probably belongs to the middle of the fifth century, while in *Meteorology* 345 A 13 are ascribed to τῶν καλουμένων Πυθαγορείων τινες two versions of an explanation of the Milky Way which are certainly very old, one might say "primitive." That Aristotle assumed differences of detail in the various theories held by this group is clear enough (cf. *Metaphysics* 986 A 22); but such differences he never implies affected the fundamental doctrine, and he almost never mentions the name of any Pythagorean identifying him as such (cf. ὁ Πυθαγόρειος Πάρων, *Physics* 222 B 18). Pythagoras himself is scarcely mentioned and never is his name associated with any of the philosophical doctrines of the school; but the Pythagoreans to whom Aristotle ascribes the theories which he discusses are represented as having been in existence in the

early years of the fifth century at any rate, since they are said either to have influenced Alcmaeon or to have been influenced by him (*Metaphysics* 986 A 27-29). So much only for Aristotle's own conception of the Pythagoreans! Although he mentions many of their theories in passing, he is interested chiefly in two, the notion of numbers and the astronomy.

The distinctive feature of the school according to Aristotle was its assumption of number as the principle; but the account he gives of this doctrine is, as has been seen, self-contradictory, for he represents it as identifying numbers and physical objects, as identifying the *principles* of number with the *principles* of existing things, and as making things *imitate* number. One might at first suppose that these were three versions of the same general theory held by different groups of Pythagoreans either simultaneously or in succession; but Aristotle makes no such distinction. He gives all three indiscriminately to the Pythagoreans and insists that the three together are a single theory (cf. pages 223-226 *supra*). Both Rey, who refers all these statements of Aristotle to the Pythagoreans who flourished from the end of the sixth century onwards (A. Rey, *op. cit.*, p. 116), and Erich Frank, who thinks Aristotle has always in mind Archytas and the Pythagoreanism of Speusippus and Heraclides Ponticus (E. Frank, *op. cit.*, p. 77 and note 196), have to assume that these three theses can be reconciled and thereby overlook the possibility that Aristotle himself may have evolved one from another by his own interpretation and for his special purposes. The only certain control in such a question would be the original writings of the Pythagoreans; and these are non-existent, for the fragments attributed to Philolaus are surely spurious, since they contain elements that cannot be older than Plato (cf. Burnet, *E. G. P.*<sup>3</sup>, pp. 279-284). Erich Frank has gathered the evidence against the fragments (*op. cit.*, pp. 263-331); and, apart from his own theory as to their origin and his inclusion of certain very weak arguments (e. g. the mistaken parallels with Aristotle on p. 290, the faulty section on cosmology, which is incidentally unnecessary for the argument, on pp. 326-328), his analysis makes it superfluous to restate the overwhelming case against them (cf. also

I. Levy, *Les Sources de la Légende de Pythagore*, pp. 70 ff. on the Πυθαγορικά ὑπομνήματα of Alexander Polyhistor).

The one certain point from which we must start is the incompatibility of the thesis, "things are numbers," with the other two; this Aristotle himself in effect admits when he repeatedly distinguishes the Pythagoreans from the Platonists by saying that the former believed in no existence save that of the objects of the phenomenal world which they identified with numbers, the numbers being the material of which all objects are constructed while the latter posited super-sensible numbers (cf. page 37 *supra*). If numbers which are things consist of a group of units (i. e. points having position) neither numbers nor things can be derived from higher principles and there can be no meaning to the sentence, "the elements of numbers are the elements of things." Aristotle's attempt to reconcile this thesis with that according to which "things are numbers" and to ascribe both to the Pythagoreans depends upon his success in finding a theory of derivation in the Pythagorean system and in one passage he admits that derivation of numbers there is none (cf. page 39). Their unit of number was clearly the materialized point (cf. page 157, note 68), and all numbers were simply congeries of such units. The notion is reflected in the definition of number given by Euclid (*Elements*, VII, def. 2): τὸ ἐκ μονάδων συγκείμενον πλῆθος (cf. ἀριθμός ἐστι σύστημα μονάδων, Theon Smyrnaeus, p. 18, 3 [ed. E. Hiller] and Nicomachus, Ἀριθμητικὴ Εἰσαγωγή, I, 7, 1). Aristoxenus in his περὶ ἀριθμητικῆς wrote μονὰς μὲν οὖν ἐστὶν ἀρχὴ ἀριθμοῦ· ἀριθμός δὲ τὸ ἐκ τῶν μονάδων πλῆθος συγκείμενον. Here ἀρχή is obviously no principle from which the numbers are generated; the monad is the beginning of number because all numbers are groups of monads. And Aristotle tells how Eurytus discovered the number of any given object by constructing its outline with pebbles and counting the numbers (i. e. the pebbles) in the outline (*Metaphysics* 1092 B 8 ff.). Eurytus was a pupil of Philolaus (Iamblichus, *V. P.*, 148), so that this doctrine is attested for the generation preceding Plato. It is the same thesis, however, namely that all continuity is an aggregation of points, which was the butt of Zeno's attack (cf. pages 155-161 *supra*);



this attack must have been written according to the chronology of Plato's *Parmenides* (127 B-C, 128 D) some time between 470 and 460. This fact alone upsets Erich Frank's thesis (*op. cit.*, p. 55) that the notion of reducing all things to number was taken by Archytas and his school from Democritus with whom it originated; Frank, himself, gives this part of his case away (*op. cit.*, p. 135) when he admits that the theses, "all is number" and "bodies consist of points" may be older than Archytas "und wirklich aus der echten pythagoreischen Lehre und ihrem Zahlenaberglauben entwickelt worden." These, however, are the very two theses which Aristotle consistently represents to be the basic principles of the "so-called Pythagoreans." If under this title, as Frank claims (*op. cit.*, p. 74), he understood only later philosophers who put their own doctrines into the mouth of Pythagoras and if the Atomists were in this sense "Pythagoreans" as much as were any of the "mathematicians," why does Aristotle never confuse Atomists and Pythagoreans? Frank is forced to admit that the answer must be that Archytas and his group really belonged to the Pythagorean sect (*op. cit.*, p. 75); but in that case there must really have been a Pythagorean number-philosophy before the Atomists which was perverted and reinterpreted by the Atomists against which reinterpretation the school of Archytas, because they were Pythagoreans themselves, protested and in their attack on Atomism in turn recast the older doctrine. Even Frank's hypothesis which would find in the "Pythagoras" of Democritus "die erste Spur der Mathematiker-Legende des Pythagoras" would require us to suppose that, if Democritus put into the mouth of Pythagoras certain non-Pythagorean "quantitative" theories, he chose this lay figure just because it was already the common opinion that Pythagoras had in some sense reduced things to numbers. If the Pythagoreans then attacked Democritus (and Frank admits that these Pythagoreans were already mathematicians [*op. cit.*, pp. 54-55]), there was before the time of Democritus a school of mathematicians who called themselves Pythagoreans and ascribed to Pythagoras himself the thesis, "all is number." With the justice and accuracy of Frank's reconstruction of a

"dynamic theory" for Archytas we need not here concern ourselves (E. Frank, *op. cit.*, pp. 126-127, 177-181); but, if this is the Pythagoreanism to which Aristotle refers, it is very strange that he not only gives no hint of the fundamental hypothesis of this system (*De Anima* 409 A 3 ff. is concerned with Xenocrates' definition of the soul; *Physics* 201 B 19 cannot refer to Archytas [cf. Eudemus *apud* Simplicius, *Phys.* 431, 8 ff. = 35 A 23, Diels]) but objects that the Pythagorean numbers take no account of change and motion (cf. pages 237-238 *supra*). Zeno's arguments show that his opponents made bodies consist of aggregates of points which themselves are material (i. e. have position) and this is the meaning that Aristotle always gives to the proposition, "things are numbers"; that the "dynamic" or "fluxion" theory which made the point *by its motion* generate the line is inconsistent with the previous notion appears from the fact that it necessitated a new definition of number which is given by Theon (p. 18, 3-4, ed. Hiller) as an alternative to the "aggregate" definition in the words ἡ προποδισμὸς πλήθους ἀπὸ μονάδος ἀρχόμενος καὶ ἀναποδισμὸς εἰς μονάδα καταλήγων (cf. Moderatus in Stobaeus, *Eclogae*, I, Prooem. 8, vol. I, p. 21, Wachsmuth, and Nicomachus, *Ἀριθμητικὴ Εἰσαγωγή*, I, 7, 1). Such a notion involves the derivation of numbers from the unit; but it no longer implies that a line is a series of monadic points, the thesis which was held by Pythagoreans at least as late as Eurytus and which is always the doctrine ascribed by Aristotle to "the Pythagoreans."

Rey, on the other hand, supposes that he can reconcile the three forms of the Pythagorean doctrine given by Aristotle (A. Rey, *op. cit.*, pp. 366 ff., 382-3, 387); but apart from merely repeating the Aristotelian method of reconciliation which has already been shown to be impossible, his treatment only introduces new inconsistencies. In one case (p. 366) he has to identify numbers with fire = limit as opposed to darkness = the unlimited and in another (pp. 382-3) to make the numbers themselves the result of the limited and unlimited. Naturally, like Aristotle, he has to ascribe to the Pythagoreans at times in this attempt two theories, one of material numbers and another of purely conceptual numbers (p. 199) and he



tries to support this notion by supposing that Zeno's paradoxes aim at two theories, the older one positing finite, indivisible numbers (or points) and the newer positing numbers which are infinitely divisible and purely conceptual. But such an explanation implies the Platonic distinction between two grades of existence, a distinction which itself is an answer to the difficulties raised by Zeno; the paradoxes depend for their validity upon the ambiguity of the unit in the continuous and show that the mathematicians Zeno was attacking had not seen even the problem involved in stating clearly the unity of their mathematical elements. Zeno's great contribution was the proof that the phenomenal unit (his antagonists recognized no other!) *must* be thought of *either* as indivisible *or* infinitely divisible and *can* be conceived as *neither*. The source of the dilemma was Parmenides' logic of Being which Zeno translated into mathematical language and applied to number monads, getting his clue perhaps from the Pythagorean embarrassment concerning the diagonal of the square. It is this same Pythagorean theory which is the kernel of the number-theory preserved in Aristotle's reports. The "alternative" theory that "the elements of numbers are the elements of things" is Aristotle's own recasting of the original thesis, an interpretation to which he was brought by his inability to understand how the notion of material number could have been seriously maintained and by the natural tendency to suppose that the Pythagoreans must have understood numbers to exist in much the same way as the Platonists did. The same source of misinterpretation is seen in his identification of the Pythagorean "infinite" or "unlimited breath" with Platonic "matter"; and in each passage where Pythagorean doctrines are expounded similar reasons explain the inconsistencies (cf. pages 17, 24-26, 36-46, 147, 164, 223-226, 237-242, *supra*). The method of deriving numbers and things from higher principles which Aristotle uses for the Pythagoreans resembles the system of Speusippus as Frank has recognized, and it is possible that Aristotle was influenced in his interpretations of this school by the teachings of his sometime master who claimed to have studied the works of Philolaus and to have based his own writings upon them (cf. Speusippus, *frag-*

*ment* 4 [Lang]; page 241, note 111 *supra*). It is not, however, likely that he merely adopted the theories of Speusippus as Pythagorean, for everywhere he distinguishes sharply between Pythagoreans and Platonists; consequently, while certain of his ascriptions to the former may have been due to the influence of the latter, it would be absurd to leave out of account the native ability and confirmed tendency of Aristotle himself to reinterpret the evidence of earlier writers to suit his own purpose. The Platonic cast given to much of the Pythagorean material (cf. Frank, *op. cit.*, p. 136) is probably Aristotle's own work, especially since the purpose for it appears easily enough in the analyses of the several passages above. In the matter of the table of opposites, for example, which Frank says was put forth by Speusippus as "Pythagorean" (*op. cit.*, p. 255), it is possible that Aristotle may have adopted from Speusippus the complete table (*Metaphysics* 986 A 22 ff.) which the latter had regularized; but, although he may have taken this as the best and most complete, he must have had evidence for the previous existence of such series in the Pythagorean school or he would have considered this one Speusippus' own and not Pythagorean. An indication of this method is seen in his reference to the opposites of Alcmaeon in this passage and in the varying emphasis given the different pairs of opposites at different times (cf. page 49, note 197 *supra*). Further proof that he did not merely copy his Pythagorean interpretations from Speusippus appears from the fact that where he represents theories similar to those of the "Philolaus" fragments he assigns them not to the Pythagoreans but to the Platonists (cf. Frank, *op. cit.*, pp. 308, n. 1, 309, n. 1); this means that, if Speusippus attributed to the Pythagoreans doctrines of his own similar to those in our "Philolaus," Aristotle recognized them as Platonistic, not Pythagorean. His use of the system of Speusippus for the recasting of the Pythagorean system becomes clear, however, when it is recalled that Speusippus makes number a synthesis of Unity and Multiplicity, his first and second hypostases (*fragment* 48 a-c [Lang]). These Aristotle identifies with *πέρας* and *ἄπειρον* and with *περιττόν-ἄρτιον* (Frank, *op. cit.*, pp. 246-7) and, since these are elements of



number in Speusippus' system, Aristotle gives them a similar rôle in the Pythagorean theory. Since for Speusippus the number *one* cannot be the same as the hypostasis Unity, it too must be generated (*Metaphysics* 1085 B 13 ff.); and this leads Aristotle to suppose that the Pythagorean unit also was generated.

The statement that the Pythagoreans explained the existence of things as due to "imitation" of numbers (*Metaphysics* 987 B 11 ff.) is clearly contradictory to the doctrine which identified numbers and things. Besides, it asserts that they agreed with Plato on the one point which Aristotle always stresses as the chief distinction between the two, for "imitation" involves the separation of numbers from things. This form of the theory is ascribed to the Pythagoreans only once, in this passage which is concerned with Plato. It is clearly an attempt to show a connection between him and the Pythagoreans, although the similarity is implicitly denied a few lines later (*Metaphysics* 987 B 29-31). The tone, position, and uniqueness of the passage seem to show that it was meant to belittle the originality of Plato and points us to Aristoxenus whose antagonism to Plato is well attested (cf. Aristoxenus, *fragments* 33 and 35, *Fragment. Hist. Graec.* [C. Müller], II, p. 282; and Diels, *Archiv für Geschichte der Philosophie*, III, p. 461, n. 26). He represented Pythagoras as likening all things to numbers (*Fragmente der Vorsokratiker* 45 B 2, Diels); and, although Frank (*op. cit.*, p. 260, n. 1) thinks this is a repetition of *Metaphysics* A, chap. 5, the presence of a reference to the *Epinomis* makes it more probable that Aristoxenus was here indicating that the Platonic theory was a plagiarism, and it is not unlikely that Aristotle in this one passage may have been influenced by the pupil who claimed to have first hand knowledge of the Pythagoreans. It is at the same time possible that Xenophilus, the Pythagorean teacher of Aristoxenus in Athens, was influenced by Plato's theory to alter the old Pythagorean doctrine by the introduction of "imitation"; but it remains significant that Aristotle does not elsewhere mention such a variation and even here makes no distinction among the Pythagoreans to whom he ascribes the incompatible theses.

The astronomical theory ascribed to the Pythagoreans by Aristotle (*De Caelo* 293 A 20 ff.) is referred to Philolaus by the doxographers (cf. Aëtius, II, 7, 7 [cf. II, 4, 15]; III, 11, 3; III, 13, 2); and one of the spurious fragments of Philolaus (*fragment* 7, Diels) seems to refer to the central fire, although, if there were no doxographical evidence with which to compare it, the fragment of itself would never have suggested this and so may have no reference to the theory at all. Erich Frank attempts to prove that the theory of a spherical earth moving about the central fire in company with the other planets was set forth by the school of Archytas, was recognized by Plato in his old age, and became the accepted doctrine of the next generation of Platonists (*op. cit.*, pp. 35, 207 ff., 252). All the arguments used to find hints of this "Philolaic" system in Plato as well as those to show that Plato at an earlier time believed in the axial rotation of the earth (*op. cit.*, pp. 35 and 205-6) had been already answered conclusively in the negative by Heath (*Aristarchus*, pp. 174-187), and this was also the conclusion of Tannery (*Revue des Études Grecques*, X [1897], pp. 127-137). Frank adduces only one bit of new evidence, the fragmentary sentence at the end of the unfinished *Critias* which says that Zeus called together the gods to their most honorable dwelling which is in the middle of all the universe; from this he argues that not earth but the central fire is meant to be in the center (*op. cit.*, pp. 217-218). Little can be made of a broken sentence from a myth; we can only say that the possibility of a central earth is not excluded as the sentence stands. A fragment of an Orphic hymn to the Mother of the Gods (Abel, *Orphica* XXVII) speaks of the goddess ἡ κατέχεις κόσμον μέσον θρόνον. Could not so much also imply in this way of arguing the "Philolaic" theory? But the next line here is saved, and it says that the center of the cosmos is earth. Whether or not Plato ever referred to the theory, his written works give no hint that he accepted it; there is evidence to show that some of his students referred the system to the Pythagoreans, but the grounds for believing that they themselves adopted it is much weaker. Aëtius (II, 29, 4) reports that Philip of Opus and Aristotle ascribed what we call the "Philolaic" system to some



Pythagoreans but not that Philip himself espoused the theory, as Frank pretends that he does (*op. cit.*, p. 206). Heraclides Ponticus may also have mentioned the theory, but Frank's attempt to prove that this was his own astronomical system (*op. cit.*, pp. 211-216) depends upon a misinterpretation of Chalcidius (*In Timaeum*, chap. 109-110). The analysis and refutation of his argument would be impertinent to this place; it is sufficient to call attention to the fact that the "Philolaic" theory which Frank claims is here given as that of Heraclides is by Chalcidius in chapter 122 ascribed to the Pythagoreans. There remains the sentence of Theophrastus (*Metaphysics* 11 A 19 ff. = Speusippus, *fragment* 41) which is generally supposed to show that Speusippus espoused the "Philolaic" system (Frank, *op. cit.*, p. 252; Theophrastus, *Metaphysics*, ed. Ross and Fobes, p. 74; Zeller, *Philosophie der Griechen*<sup>4</sup>, II, p. 1000, n. 3). There is, however, nothing expressly astronomical about the sentence (which, incidentally, seems to be corrupt) nor is the context astronomical; and whatever the reference be it is impossible to reconcile the interpretation that makes τὸ τίμιον . . . τὸ περὶ τὴν τοῦ μέσου χώραν the central fire with Speusippus' theory that the Good is the end of development and not the hypostasis Unity (cf. Ross and Fobes, *op. cit. ad loc.*). The interpretation, in fact, depends upon the supposition that Aristotle in *De Caelo* 293 A 27 ff. meant that Speusippus also accepted the "Philolaic" system, while this interpretation of the *De Caelo* is supported by referring in turn to the passage of Theophrastus. But Aristotle does not say that anyone beside the Pythagoreans adopted the theory; he merely says that many others too, if they proceed from *a priori* principles rather than the phenomena, could approve the theory. Then after giving these principles he says that if they reckon from them they do not really believe the earth is at the center (N. B. ἂν . . . συνδόξειε . . . τὸ πιστὸν οὐκ ἐκ τῶν φαινομένων ἀθροῦσιν is clearly conditional and does not refer to any particular persons; ἐκ τούτων ἀναλογιζόμενοι οὐκ οἴονται also expresses a condition, not a fact. The present indicative is common in such preliminary deductions, cf. *Physics* 209 B 5: οὕτω . . . σκοποῦσιν ὁ τόπος τὸ ἐκάστου εἶδος ἐστίν. ἧ δὲ δόκει κτλ. Cf. *De Caelo* 277 B 30 and, for an

obviously hypothetical deduction, ὥστε . . . ἀνάγκη . . . οὕτω σκοποῦμένοις, *Metaphysics* 1029 A 19). The *a priori* principles themselves were not only accepted by Platonists but were also employed by Aristotle himself at times (cf. page 343 f. *supra*). Consequently, while the meaning may be that the Platonists must adopt the theory if they are true to their principles, the main point is that unless one look to the phenomena anyone who adopts these commonly accepted principles would have to concur with the Pythagoreans. The further reasoning of the Pythagoreans, however, does not demand general assent (293 B 1 ff.; cf. Simplicius, *De Caelo*, 512, 23-513, 13). So our evidence shows only that the Platonists mentioned the "Philolaic" system as a Pythagorean theory, and the notion that Aristotle mistook their own orthodoxy for an older doctrine is left without a foundation.

Frank's thesis that the system in question must be later than Archytas is made to depend upon a proof that the sphericity of the earth was discovered by Archytas and his school. His method of establishing this is to find in Plato's dialogues indications that the discovery was recent (*op. cit.*, pp. 25-26, 174). But in *Phaedo* 108 C ff. the novelty of the theory does not lie in its assumption of sphericity but in the distinction between the "true surface" and the rugged surface of ground and water with its many basins. The fact that the earth is round is expressed in a subordinate clause as the accepted fact on which depends the notion of equilibrium at the center. The latter notion was as old as Anaximander (cf. Aristotle, *De Caelo* 295 B 10 ff.). This is but the introduction to Socrates' new theory and Simmias assents to it vehemently and without surprise (*Phaedo* 109 A 8). The "new theory" of *Laws* 966 D ff., likewise, is not the "mathematical regularity of the shape of all heavenly bodies" but the notion that these bodies must all be ἔμφυχα. This is τὸ νῦν ὄντως δεδογμένον as is proved by the statement that even before (τότε) some came near to this very truth when they said νοῦς εἶη ὁ διακεκοσμηκὺς πάνθ' ὅσα κατ' οὐρανόν (i. e. Anaxagoras, *Laws* 967 B 4-6). Frank's attempt to show that the notion of a spherical earth was impossible before approximately 400 B. C. (*op. cit.*, p. 186) requires that he deny the

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testimony of Theophrastus that ascribes it to Parmenides. To do this he has to insist that *στρογγύλη* cannot mean spherical (*op. cit.*, pp. 198-200), a position which Friedländer (*Platon I, Eidos, Paideia, Dialogos*, p. 243, n. 1) has sufficiently refuted. The word is not so exact as *σφαιροειδής*, to be sure; it stands to that term as "round" to "spherical," which consideration justifies Parmenides' application of it to the earth while reserving *σφαιροειδής* for the universe.

The "Philolaic" system also presupposes, according to Frank (*op. cit.*, p. 35) axial rotation; and he ascribes this discovery to the school of Archytas a few years before. The evidence for this is the axial rotation which he believes to be espoused in the *Timaeus* (*op. cit.*, pp. 205-206); but this interpretation is, I think, impossible, and Frank himself admits that it is inconsistent with the rest of the *Timaeus* astronomy and that Aristotle's interpretation was probably influenced by Heraclides. Since the latter, however, espoused a system including axial rotation, he probably was the author of this interpretation of the *Timaeus* passage, by which means he tried to find a precedent for his own doctrine; in that case Aristotle's testimony in this matter is vitiated. At the same time there is no other indication that Archytas or his school espoused either the theory of axial rotation of the earth or that of an earth revolving about the central fire; rather, if, as Frank believes (*op. cit.*, p. 35 and note 69), Plato in the *Timaeus* followed a "planetarium" of Archytas, the indication is that Archytas too represented the earth as central and stationary. The theory of Eudoxus, who was his pupil, suggests the same conclusion.

As Burnet has remarked (*E.G.P.*<sup>3</sup>, p. 298) the theory of the sun attributed to Philolaus (Aëtius, II, 20, 12) resembles that of Empedocles and probably points to the approximate era of the hypothesis. At any rate evidence for its formulation or even for its support in the generation of Plato and that of his immediate pupils is entirely lacking; and we can only accept Aristotle's statement that it was a Pythagorean theory and suppose it to have been invented somewhere about the third quarter of the fifth century.

The "harmony of the spheres" probably was varied in detail

from time to time in an attempt to fit it to the newest theories of planetary motion (cf. Heath, *Aristarchus*, pp. 107 ff.); but there is no reason to doubt its antiquity in one form or other. Frank (*op. cit.*, pp. 34, 174, 201-202) insists that it cannot be older than Archytas because it implies his discovery of the inverse ratio between the speed of vibration and the length of the vibrating string. But this would be a "necessary antecedent" of only one form of the theory; and our evidence rather shows that the Pythagoreans were very vague about the connection of the harmony with the distances and velocities of the planets (cf. Heath, *op. cit.*, pp. 107-115). In order to support his theory, therefore, Frank has to assume that the assignment to the planets of fixed paths at various distances from the earth was itself the work of Archytas. Yet the theory of Democritus which explained the retrogression of the planets by the "lagging" due to their position in the whirl (Lucretius, V, 621 ff.) is based upon the notion that the lagging bodies are at various distances from the earth; and free motion of the planets is assumed in the theory of Alcmaeon and "some mathematicians" (i. e. early Pythagoreans; cf. Heath, *op. cit.*, pp. 50-51; Tannery, *Pour l'Histoire de la Science Hellène*, p. 208) according to which the planets have a motion contrary to that of the fixed stars. It is not necessary that the true paths of all the planets be determined before such a fancy as the "harmony" could arise; even the distances which Anaximander attributed to the sun, moon, and fixed stars may be connected with such a notion which was more probably drawn at first from number-mysticism than from scientific acoustics (cf. Heath, *op. cit.*, pp. 37-38; P.-M. Schuhl, *op. cit.*, pp. 261-263). The attribution of the theory to Archytas is made the more doubtful by the fact that the reason which Aristotle's Pythagoreans give for our being unaware of the heavenly sound (*De Caelo* 290 B 25 ff.) is not of the kind Archytas would probably have given who claimed that some sounds were too great to penetrate the organs of hearing (Archytas, *fragment* 1, vol. I, p. 332, lines 6 ff., Diels).

After Parmenides had attacked the foundation of all previous philosophy by asserting the identity of Being, it appeared that



change of all kinds, even that of position, was impossible. At the same time the characteristic of Being apparently excluded all other characteristics and so made multiplicity impossible. The Pythagoreans who in their cosmological physics seem to have followed the Ionians, Anaximander and Anaximenes, (cf. ἄπειρον κενόν = πνεῦμα, page 25 *supra*, already criticized by Xenophanes [Diogenes Laertius, IX, 19; cf. Plato, *Timaeus* 33 C 3-4 and A. E. Taylor *ad loc.*]) turned upon Parmenides with an argument from absurdity, evidently using the method in which many of their geometrical proofs were cast (Plato, *Parmenides* 128 C 7-D2; cf. A. Rey, *op. cit.*, pp. 201-203) to show that his thesis resulted in a denial of multiplicity which itself was self-contradictory. Against them, then, Zeno turned their own dialectical method and, making the object of his answer the hypothesis of monadic points which was the foundation of their whole mathematics, "gave them as good as they brought and better" by proving that their own hypothesis of multiplicity ended in still more ridiculous contradictions (Plato, *Parmenides* 128 D 2-6; cf. Simplicius, *Phys.*, 139, 5). Thereafter there was nothing to do but accept one horn of the terrible dilemma on which the Pythagorean *mathematica universalis* had been impaled; one had either to make the constituent parts atomic or assert infinite divisibility of matter and in either case accept the consequences that Zeno had prepared.

But before this alternative had been clearly drawn with all its implications Empedocles attempted to reconstruct physical philosophy by adopting the logic of Parmenides. The requirements of the new law of identity had destroyed the possibility of change; one could, however, set up a body with definite qualities if only one were careful to say that such as the body is it always has been and always will be. If, then, there are several such bodies with different characteristics, the mingling and rearranging of these bodies should be able to produce all the varied complexes of phenomena just as the limited palette by mixture and proportion becomes an infinite number of complex shapes and colors (*fragment* 23). Still, since all that exists are the few bodies in the various mixtures and since these have in no wise changed, Parmenides' objection should be met and the

phenomena saved at the same time (*fragment* 26, lines 8-12). Empedocles had discovered—or adopted from some other discoverer—the fact that air is material body; he therefore added this to the three phases of Heraclitus' process (earth, water, fire; cf. Diogenes Laertius, IX, 9 and Heraclitus, *fragment* 31, Diels) and, defining them according to the Parmenidean principles, arrived at the four "roots" all "equal" and together forming all that is, all else being only various mixtures of these four (*fragments* 17, lines 27-35; 12; 71). As these four "roots," however, were really four physical copies of Parmenidean Being, each was a single homogeneous body steady and unmoved and it was necessary for Empedocles to find something else to bring about their "mixture." In the world of animals, in which he displayed so much interest, he found such a thing, the force of "Love" which pervading the body drives it to "mingle" with another body; and this force Empedocles raised to cosmical significance. As it pervades the roots it brings them into a state of mixture with one another which is more complete the more thoroughly the force has occupied the roots. Here, too, the demands of identity presented a problem. If this force was essentially the "mingling" cause, it must not have the contrary character; and, since the complexes of "roots" obviously are dissolved and this mingling and dissolution must alternate continually if the world is to go on as it does, another force was required to break up the mixtures caused by "Love." This must, of course, be "Strife" which also can be seen, the opposite of "Love," in all animals. The mistakes that Aristotle made in treating this system we have already considered (cf. pages 188 ff. and 190, note 193 *supra*). It is evident that the great flaw in the theory is the neglect of the problem of part and whole; when "Love" has "thoroughly mixed" the four roots, it appears that there must be minimal parts of these roots, but Empedocles did not consider this. It is the same kind of difficulty as that which Zeno uncovered in the Pythagorean mathematics, and we have seen that there is some reason for believing that he attacked the system of Empedocles in a similar fashion (page 95, note 401 *supra*).

Anaxagoras, who was brought up in the Ionian tradition and



probably came into contact with Eleaticism only afterwards, saw that the older form of his philosophy had to be remodelled. The history of his development under this influence we do not know, for his book was written only after he had so far accepted the corrections of Parmenides that he could criticize Empedocles for transgressing them. Yet the basis of his theory of matter is really the system of Anaximander. Much counsel has been darkened by the misinterpretation of a remark of Aristotle (*Metaphysics* 989 B 5-6) which historians represent as showing that to Aristotle Anaxagoras seemed much more "modern" than Empedocles (cf. E. Frank, *op. cit.*, p. 83; P.-M. Schuhl, *op. cit.*, p. 297). The passage says, however, that if one were to articulate clearly what Anaxagoras meant to say he would perhaps be seen to have a more modern theory; and then Aristotle proceeds to show that, if the original mixture be interpreted as unqualified, Anaxagoras can be shown to have espoused his own theory of pure potency as matter opposed to form. Obviously this has nothing to do with Anaxagoras' theory at all, so far as the historian is concerned who should know how wary to be in this case when he sees that the same interpretation is offered for the material of Anaximander, Empedocles, and Democritus elsewhere (cf. pages 53 ff., 141 ff. *supra*).

Anaxagoras, like Empedocles or rather like Anaximander, explained all apparent change by the aggregation and segregation of particles. To Empedocles, however, he objected that there is no reason for singling out earth, air, fire, and water as the only bodies of which the Eleatic law of identity need be asserted. Hair and flesh have characteristics of their own and, if nothing comes into being, hair and flesh must preserve their identity eternally (*fragments* 10 and 17). To paraphrase Anaxagoras' objection, he saw that Empedocles was coming perilously close to a derivation of new characteristics from quantitative differences and this to his mind was inadmissible on the basis of Eleatic logic. Empedocles, to be sure, was not aware of introducing such a doctrine, for the new complex was characterized only by the characteristics of the ingredient roots and varied with the quantity of those roots in the mixture; but Anaxagoras insisted that the "new complex" was as much of an entity as

the arbitrarily chosen roots and must always remain essentially identical. There was then only one way to explain apparent change, namely to suppose that everything is a mixture of everything just as was the precosmical mixture and that there are particles of everything in everything (*fragments* 4 and 6). This is true of water, earth, etc. just as it is of all natural bodies that appear to be homogeneous. Anaxagoras' polemic against the special nature of the four roots and Aristotle's confusion of the "seeds" and the great masses of air, earth, etc. (cf. pages 2-3; 4, note 14; 108, note 444; 120, note 489) have misled interpreters who talk as if earth, air, fire, and water were the four things in this system for which there are no seeds. Such a notion would contradict the first principle of Anaxagoras; it is moreover refuted by his own words (*fragment* 1: ταῦτα [i. e. ἀήρ τε καὶ αἰθήρ] γὰρ μέγιστα ἐνεστὶν ἐν τοῖς σύμπασι καὶ πλήθει καὶ μεγέθει and *fragment* 4: καὶ γῆς πολλῆς ἐνεούσης καὶ σπερμάτων ἀπείρων πλῆθος κτλ.). Aristotle is also responsible for the confusion which has been introduced into modern interpretations by the curious notion that the "contrary qualities" are on a different level from the "seeds." (The dry, moist, warm, cold, bright, dark of *fragment* 4 are specifically called χρήματα; καὶ γῆς . . . ἀλλήλοις is a genitive absolute giving the cause for the preceding statement.)

That everything is in everything seems to be a hard doctrine; but it is consistent with the firm answer given by Anaxagoras to Zeno's dilemma. Matter is infinitely divisible; there is no least part, and for that very reason there can be no complete separation and everything *must* contain some of everything else (*fragments* 6, 8, 12). Incidentally, this theory delivers him from the necessity of assuming two contrary forces. Like Empedocles he felt it was impossible to get the necessary motion for his process of separation from matter itself and so had to posit a force which would have no similarity to matter. But since the process of separation can have no end on his theory, there is no term set for the process at which a contrary force is needed to bring things back the opposite way and so preserve activity. Commingling (*fragment* 17) he admitted, but it was a simultaneous consequence of the motion set up by the separating force.



Both Empedocles and Anaxagoras, under the influence of Parmenides' banishment of non-Being and the discovery that air is a body on the same level of materiality as earth and water, had denied the existence of void. All change they had reduced to local translation, and local translation in the absence of void became simply rearrangement; this kind of "change" seemed to them not to transgress the laws of Parmenides so long as the unit in the rearrangement kept its identity. But now arose another Eleatic to object that all change of whatever kind is impossible. Melissus of Samos whom Aristotle dismissed as a vulgar thinker who "materialized" the conception of Parmenides, an interpretation due to the application of Aristotle's distinction of formal and material cause and the desire to find this distinction even among the Eleatics, applying the strict Eleatic logic to the systems of Empedocles and Anaxagoras showed clearly that they were self-contradictory. If there is no void, as they both presume, there can be no motion of any kind (*fragment 7*, sect. 7-10); this alone destroys the mechanism of the two systems, but Melissus added another argument on the basis of identity. The arrangement of the world, if it exists, must obey the laws of existence too; as existing, this arrangement cannot change, for how can it any more than that of which it consists change its characteristics? Therefore, rearrangement itself is a denial of the law of identity and so an impossibility (*fragment 7*, sect. 3). Process of any kind implies a moment of initiation both temporal and spatial and that moment involves the appearance of characteristics of arrangement at least which did not before exist. This, however, is an impossibility and consequently there can be no differentiation of any kind, an axiom which in turn establishes the complete homogeneity and infinity of extension of all that exists (*fragment 2*). So not only the process assumed by Empedocles and Anaxagoras but also the differentiation of material in their systems is incompatible with the laws established by Parmenides. The separation which this differentiation implies itself involves motion; and since motion is impossible the one means of differentiation which had seemed to remain for those who accepted Parmenides' arguments is shown to be inconsistent with them (*fragment 10*). Melissus

added a dialectical "indication" of the validity of his conclusion concerning the homogeneous unity of all Being, the historical consequences of which Burnet has pointed out (*E.G.P.*<sup>3</sup>, pp. 328-329). It is obvious that even Empedocles and Anaxagoras had to deny the evidence of the senses in maintaining the truth of their theories; whatever units of existence they assume do not, as far as our senses go, observe the laws of unity and identity which both philosophers admitted must hold for those units. That, however, amounts to admitting that the evidence of sensation cannot be adduced against Melissus and that the logical laws are stronger than any such evidence. From the arguments of both Empedocles and Anaxagoras, therefore, it follows that if one were to assume a multiplicity of units each would have to be exactly what Melissus says the one Being is (*fragment 8*).

The influence of this reasoning upon the Atomists is clear. Since it was no longer possible to assume motion without assuming a void, Leucippus and his followers accepted the challenge and asserted the real existence of such a vacuum. As Melissus had shown that a commencement of motion contradicts the law of identity, the Atomists abandoned such forces as Anaxagoras' *voûs* and, articulating the old Ionic notion, made constant motion one of the essential characteristics of all matter. The qualitative differentiation, which both Empedocles and Anaxagoras had assumed to be necessary in their real existences if the complexes were to display these characteristics, Melissus had overthrown by his proof of the necessary essential identity of all material; but, since the sensations could not be defended as true witnesses anyway, the Atomists asserted the essential identity of all their material particles and simply denied that the characteristics apparent in complex bodies had any existence at all. Anaxagoras had laid himself open to the attack of Melissus by asserting the infinite divisibility of matter whereby any two bits of matter could be said to differ only in size so that Melissus could argue that Anaxagoras himself admitted that each of his multiple parts was exactly like the whole and gave no reason for assuming difference except the arbitrary division which involved an initiation of motion. The



Atomists took the other horn of the dilemma: the particles of matter are indivisible and unchangeable; they differ only in size and shape, and, except for motion, which with these two differentiations constitutes the eternal and unalterable characteristics of the particles, they have no other characteristics at all. Anaxagoras in his thorough-going consistency had had to assert that everything is in everything if the characteristics are real; but this had been shown by Melissus to amount to a denial of difference between the whole and the parts. All these characteristics were then useless, and Leucippus simply sloughed them off and denied their existence. The apparent differences of complex bodies was explained as a difference of the number, size, shape, arrangement, position, and motion of the atoms in the void.

Aristotle not only overlooks the importance of Melissus and Anaxagoras in the development of Atomism (cf. pages 95, note 401; 113-114; 220-221 *supra*) but, because he neglects the development of the problem of motion and change and misinterprets the Presocratic conception of qualitative characteristics, he tries to show that the Atomists did assume a qualitative differentiation in the atoms (in that he confuses the atoms and the bodies they constitute [pages 120; 262, note 181; 289 ff. *supra*]) and neglects the importance of the motion and force of the atoms and the implications of the process of reconstitution of atomic complexes (pages 119-120; 289 ff. *supra*). The extent of his misinterpretation is to be seen in his attribution of relativism and logical nihilism to Anaxagoras and the Atomists as well as to Heraclitus (cf. pages 77-83 *supra*).

The use to which in his writings Aristotle has put the Presocratic theories has not only perverted details but has also obliterated the problems these theories had to meet and obscured the relationship of the doctrines to one another. The analysis above should give an indication of the extent to which a correction of Aristotle's statements must affect the critical problems of the history of Presocratic philosophy.

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